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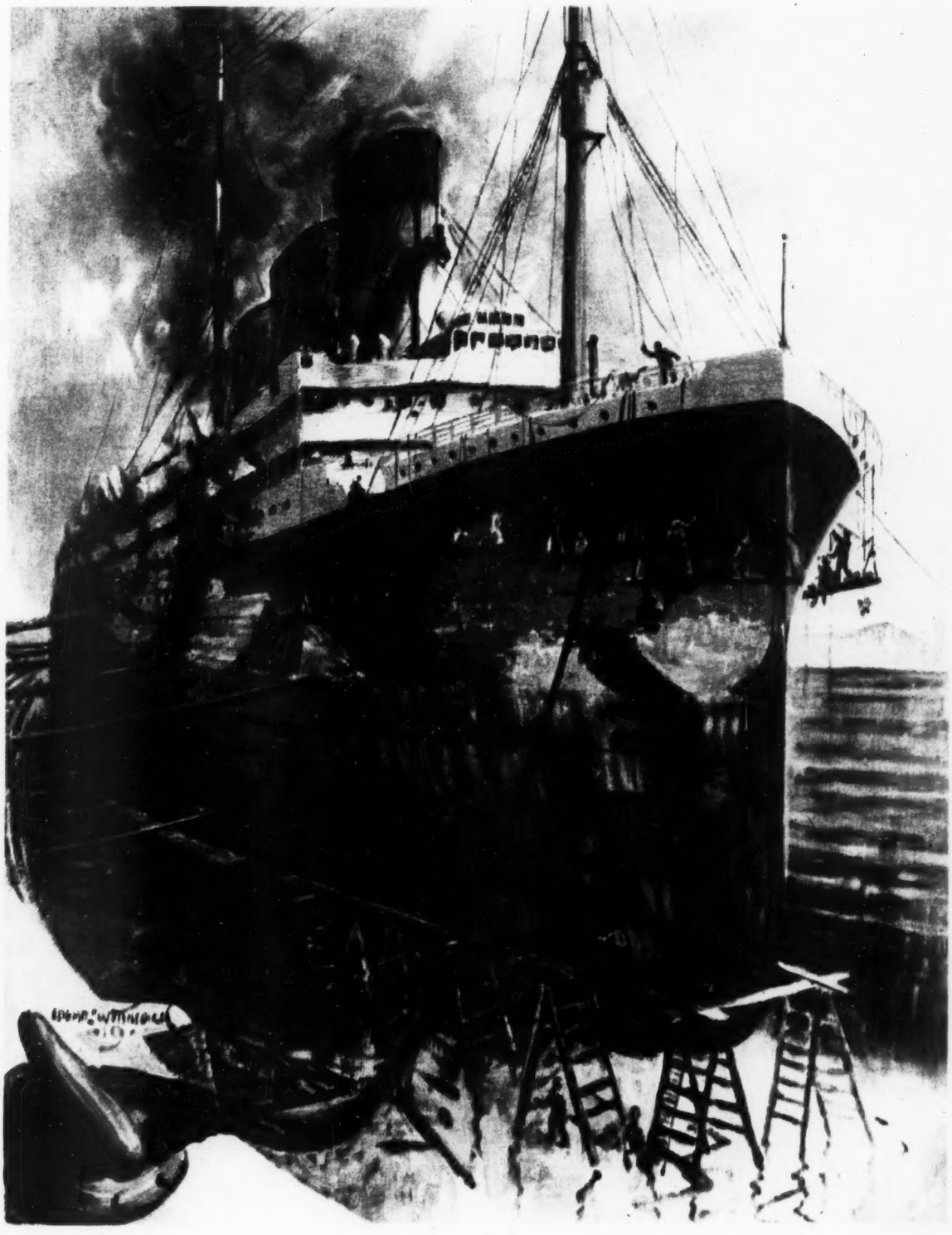

PREPARING FOR PEACE SERVICE—PAINTING OUT THE CAMOUFLAGE

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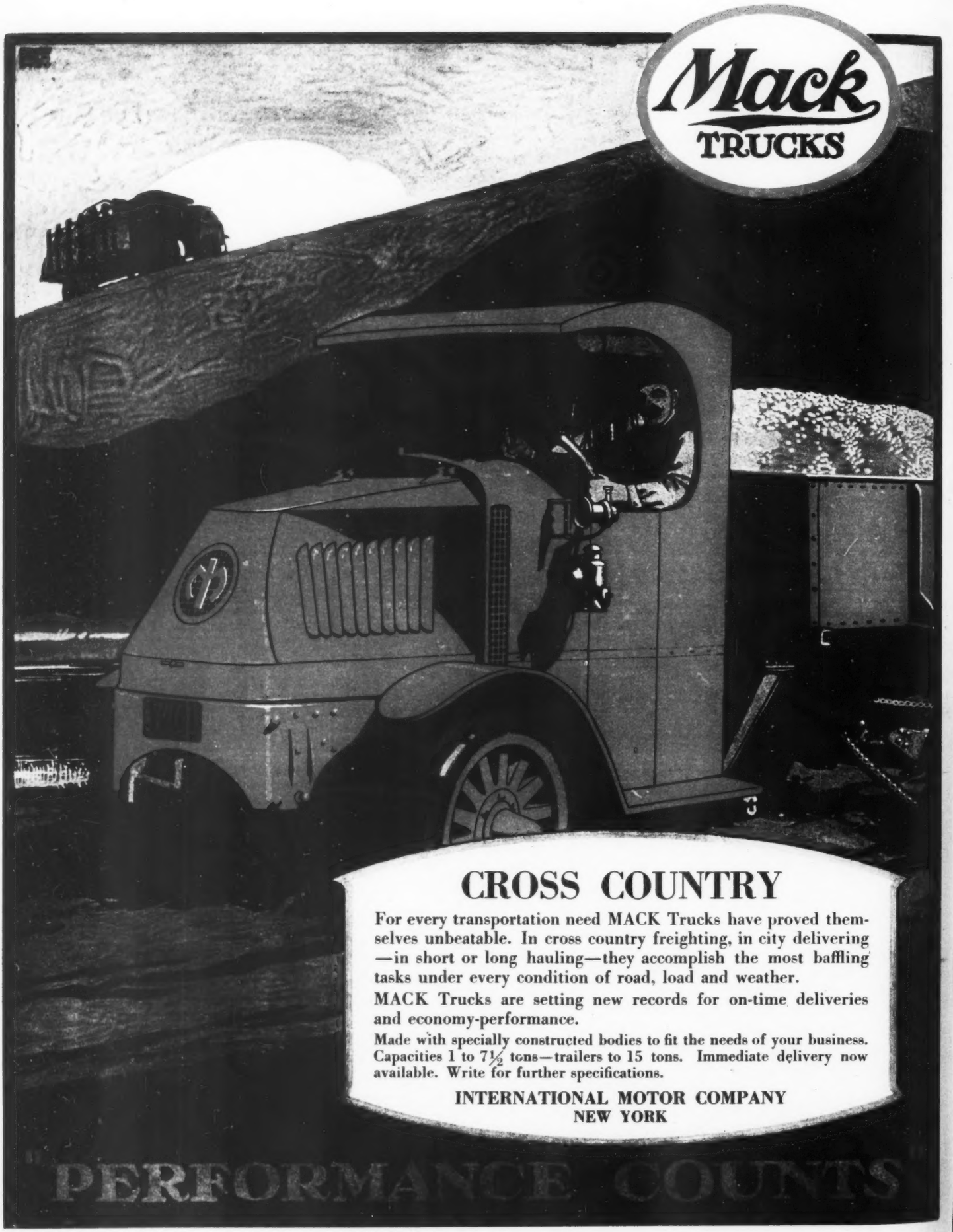

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SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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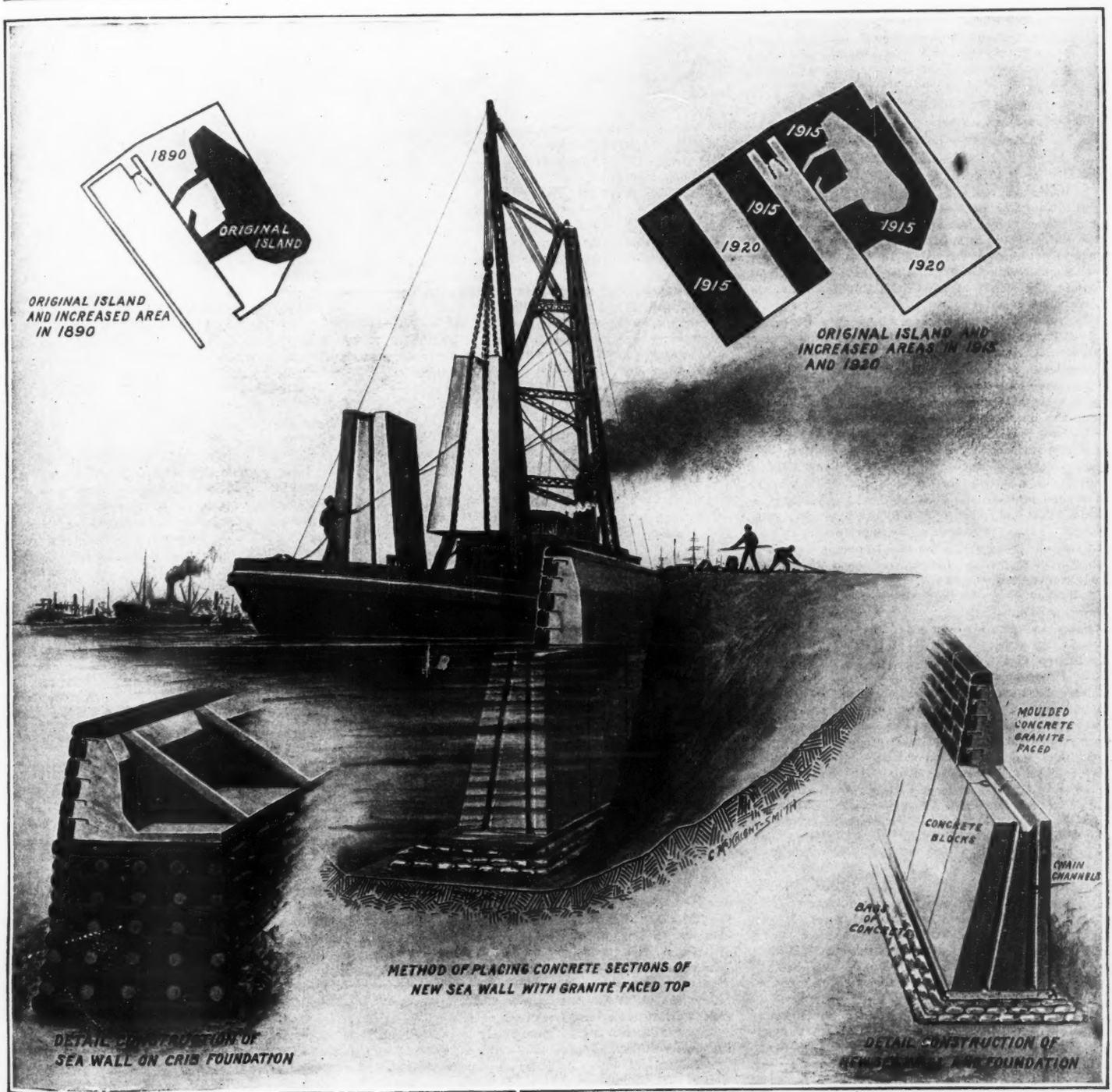

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Rebuilding the seawalls of Ellis Island and adding to its acreage. (See page 427)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Jellicoe on the Grand Fleet

SELDOM, if ever, has the commander-in-chief of naval or military forces given to the public so candid and illuminating a story of his war experiences as is found in the 500-page volume, written by Admiral Jellicoe and published by the George H. Doran Company of this city, under the title "The Grand Fleet." The book produced a positive sensation upon its first publication in London—as well it might; for the British people learned for the first time upon how slender a thread, in the first few months of the war, hung the fate, not merely of the British Empire, but of the whole Allied cause.

The work has been spoken of as an "apologia"; written for the express purpose of defending the author against criticisms of his strategy and particularly of his tactics in the famous battle of Jutland; but we are free to confess that a careful reading of the book has left no such impression upon our mind. Rather we carry away the impression of a straightforward story, told with characteristic "sailorman" frankness, of the day-by-day experience of the fleet, as viewed from the position of its commander-in-chief. Had the Admiral been writing a private diary of the war, he could scarcely have been more frank in his statements of defects in strategy that had evidently been imposed upon him from without, or in his revelation of the unpreparedness, both of the Grand Fleet and of its naval bases in the North Sea, for the stupendous task with which it was so suddenly confronted.

And reading between the lines, those of us who follow the course of naval affairs in the United States, are able to place the blame for unpreparedness where it belongs. It was not the fault of the Jellicoes, the Percy Scotts, and the Beattys of the British navy that the Grand Fleet, short of destroyers, short of submarines, short of scout-cruisers, short of up-to-date range-finders and search-lights, was ordered to Scapa Flow, an utterly unprotected base open to destroyer and submarine attack—no more their fault than it was the fault of our own Deweys and Simses and Fiskes that our battleship fleet was less than one-half of its proper and necessary strength, and that the fleet we possessed was wofully short of scouts and destroyers, and had no battle-cruisers whatsoever.

So long as naval appropriations are made the sport of the politicians, a great naval power like the United States or Great Britain will be continually faced with the possibility of disaster. And so long as a politician like Churchill can force a Grand Fleet to do its coaling in an open and undefended harbor opening onto submarine-infested waters, or bring strong pressure upon that fleet (as Churchill actually did) to engage in such a mad venture as a bombardment of the Heligoland forts, the morale, even of the high command, will be disturbed and their sureness of themselves and their strategy shaken.

It is amazing to learn how slight was the superiority in capital ships and how decided the inferiority in destroyers and light cruisers of the British to the Germans in the North Sea during the early months of the war. Being the blockaded fleet, the Germans could elect to come out when every ship of the High Seas Fleet was in perfect shape. The British, due to continual cruising in one of the stormiest of seas, always had some ships undergoing refit or repairs. Thus, Admiral Jellicoe tells us that towards the close of October the Grand Fleet was considerably weakened, apart from the fact that it had lost the "Audacious." The "Ajax" had developed condenser defects; "Iron Duke" had similar troubles; the "Orion" had to be sent to Greenock for examination of the turbine supports, which appeared to be defective; the "Conqueror" (all of these it should be noted are dreadnought battleships) was at Devonport refitting, and the "New Zealand" was in dock at Cromarty. The "Erin" and "Agincourt," having been newly commissioned, could not yet be regarded as efficient; so that the dreadnought fleet consisted only of 17 effective battleships and five battle-cruisers. The German dreadnought fleet at the time comprised 15 battleships and four battle-cruisers with the "Blucher" in addition. Everyone will agree with the Admiral when he says, "The margin of superiority was therefore unpleasantly small in view of the fact that the High Seas Fleet possessed 88 destroyers and the Grand Fleet only 42."

Admiral Jellicoe says that he often wondered why the Germans did not make greater efforts to reduce the British strength in capital ships by destroyer or submarine attacks on the British bases during those early days. "They possessed," he says, "in comparison with the uses for which they were required, almost a superfluity of destroyers, certainly a superfluity as compared with ourselves, and they could not have put them to a better use than in an attack on Scapa Flow during the early months of the 1914-1915 winter."

Speaking of the frequently-made suggestion that the Grand Fleet should make an attack upon the High Seas Fleet at anchor in its home port, he says: "They not only possessed the most powerful and ample artillery defences, but we knew also that the Germans had a very efficient mining service, and we were justified in assuming that they had protected their naval bases by extensive mine-fields. We, on the other hand, were entirely unprovided with this particular form of defence."

Taken altogether, it is evident that the Germans missed their great opportunity at this very time. How they failed to know of conditions at Scapa Flow is puzzling, to say the least. The Zeppelins should have provided this knowledge. The Admiral's own suggestion is that "it may have seemed impossible to the German mind that we should place our fleet, upon which the Empire depended for its very existence, in a position where it was open to submarine or destroyer attack." Reading between the lines it is very evident that Admiral Jellicoe and his staff were not responsible for the selection of Scapa Flow as the naval base in those perilous days.

The Revival of Amateur Wireless

THESE are gloriously busy days for a certain class of Young America familiarly known as the wireless amateur. In the attic or basement, city bedroom or backyard shed, he may be found in his spare moments hard at work getting his station in order. The accumulated dust is being wiped off tuning coils, telephone receivers, and variable condensers, and the various components are being feverishly assembled and wired to receive the wireless signals. And in many instances there is a sense of restless expectancy not unlike that which comes upon one waiting for the curtain to rise for the decisive act of a play; for the fact is that much has been done in wireless telegraphy and telephony during the past two years, and there are many new and strange signals ready to greet the amateur.

It was the recent statement of Acting Secretary Roosevelt of the Navy, to the effect that all restrictions on receiving wireless stations were raised as from April 15th last, that revived amateur wireless. Ever since the war the amateurs had been prevented from transmitting and receiving; and while many are disappointed that only the receiving restrictions have been removed, all are agreed that the Navy has at least made a start toward the freedom of the air, so to speak, as in former days of peace. It cannot be much longer before the restrictions on transmitters will also be removed, restoring amateur wireless to its pre-war status.

Amateur wireless is to be more firmly established than ever before. Having been successful in warding off proposed laws intended to stifle amateur wireless from time to time in the past, the young and old Americans engaged in this most remarkable of all hobbies are in a better position than ever to maintain themselves. Surely, if would be an ungrateful government that would again challenge them after their remarkable record in our war efforts.

Aside from having supplied some ten thousand radio operators, who stepped into the Army and Navy practically ready to be put to work, the wireless amateurs of this country supplied our Government with leading radio engineers. Major Edwin Howard Armstrong, for instance, has been a New York amateur, and President of the Radio Club of America. During the war, he has been in charge of the Radio Research Section of the U. S. Signal Corps in France. He is the inventor of the well-known regenerative vacuum tube circuits, which greatly helped to solve Navy radio communication problems. He helped to perfect the radio receiving sets for airplane use, thus permitting instructions to be received instantly instead of by means of cloth strips on the ground, as formerly. He designed a very efficient multi-stage amplifier for use in amplifying the weak currents in small receiving loops, and so on. He has been an assistant to Prof. M. I. Pupin of Columbia University, and the winner of the gold medal of the Institute of Radio Engineers for the best radio invention.

Then there is T. Johnson, Jr., Director of the Radio Club of America in peace times, and Expert Radio Aide, U. S. Navy, in charge of technical division of the Naval Aircraft Section, during war. He was the organizer of the foregoing-mentioned division, which, within a few months, had in operation radio telephone sets on board most Naval seaplanes, which greatly helped to patrol our coast during the U-boat scare. Lieut. H. Sadenwater, U. S. N., radio officer in charge of the radio technical work on Navy NC planes that will start across the Atlantic, also a Director of the Radio Club; Ensign Frank King, U. S. Navy, radio officer in charge of Radio Laboratory for Aircraft Radio at Norfolk, Va., and later radio officer in charge of Navy aircraft radio work in France, who is a past president of the Radio Club of America; Ensign George Eltz, U. S. Navy, radio officer in charge of Radio Laboratory for Aircraft Radio at Norfolk, and later in charge of radio work in England—these, and many more, are old-time wireless amateurs whose hours upon hours of experimentation and tinkering were capitalized to the end of helping the United States win the war.

So there can be no doubt that the wireless amateur has proved his right to existence. He reënters into his hobby with a broader knowledge of wireless in particular and electricity in general. Wireless communication is more mysterious than ever, and promises far more in the future than was ever believed possible. Long live the wireless amateur!

Popularizing American Aviation

AVIATION is a thing which requires constant advertising if it is to survive. Before the world war, England, France and Germany kept up public interest in airplanes by aviation meets, huge prizes, and spectacular feats. In marked contrast, little was done in America, and as a natural result the public cared little about airplanes. When we entered the war, our aeronautical equipment was conspicuous by its smallness and general backwardness.

In order that we may not lose our splendid position in the aeronautical world, which we have gained through almost two years of intensive war efforts, it is to be hoped that airplanes and airships will be kept before our people. In this connection the coming Second Pan-American Aeronautic Convention and Exhibition is a hopeful sign of our future aeronautical policy. This gigantic undertaking will be held from May 1st to June 1st, 1919, inclusive, at Atlantic City, N. J., under the auspices of The Aero Club of America, The Aerial League of America, and the Pan-American Aeronautical Federation. Exhibitions of the latest types of lighter- and heavier-than-air machines, the reading of technical papers by the leading men in the aeronautical industry, motion pictures and lantern slides, races and contests of all sorts for all classes of machines, parachute contests, intercollegiate contests, aviette (bicycles and motorcycles with wings) contests—all these things are features of the remarkable program for the month of May, 1919, at Atlantic City, N. J. The governments and aeronautic, sporting, scientific, industrial and civic organizations of the United States and all the countries of the world, excepting Germany and her allies, are invited to send representatives to attend this great aeronautic event.

Naval and Military

Training for American Merchant Marine.—The United States Shipping Board recently announced that, since the establishment of its squadron of merchant marine training ships in January, 1918, up to the first of April of this year, 22,523 American citizens were accepted for training on the ships as apprenticed sailors, foremen and stewards. The course of training is two months and the Board announces that it now wants 2,000 more young men for the training as apprentices.

Zeppelins as Naval Scouts.—The Germans demonstrated during the war the supreme value of Zeppelins for naval scouting. Admiral Sims in urging the construction of these airships refers to the trip of a German Zeppelin from Jamboli in Bulgaria with supplies for the German force in East Africa. When she had proceeded beyond Khartoum, she was recalled by radio because of the surrender of the German forces. She covered 4,800 miles without a stop and was aloft for 105 hours.

To Organize a Trench Mortar Regiment.—The wartime organization of trench mortar batteries with the divisions is to be abandoned in favor of a single trench mortar regiment, which will be organized as a part of the army artillery to be assigned for duty by the army commander. Trench guns resulted from stabilized trench warfare, and the divisional batteries lost their usefulness excepting under special conditions when the Allied attack turned the warfare into an open struggle. For that reason, the trench mortar units of all divisions were among the first to be sent home.

Port Facilities in the United States.—The United States Shipping Board has drawn up a list of ports and harbors of the United States which are capable at mean low water or mean high water of accommodating vessels of 3,300 gross tons, with a maximum draft of 24 feet. They are listed in three classes with 24 in Class A, 10 in Class B, 29 in Class C, and 8 in Class D, making a total of 71 ports capable of accommodating ships drawing 24 feet. Nature has been bountiful in providing our 21,000 miles of coastline with deep landlocked bays and broad estuaries which offer safe harbor to ships of all classes.

Artillery in the Late War.—In his final dispatch, Field Marshal Sir Douglas Haig gives some striking figures showing the growth of ordnance. In 1914 the British had one machine gun to 500 infantrymen; in 1918 they had one machine gun to 20 infantrymen; and their artillery rose from 486 guns at the outbreak of the war to 6,437 at the signing of the armistice. On the first day of the Somme battle in 1916, 13,000 tons of ammunition were fired by the British; in 1917 on September 20th and 21st, 42,000 tons were expended; and in the three days when the British broke down the Hindenburg line, September 27th to 29th, 1918, nearly 65,000 tons of shells were fired by their artillery.

Men Versus Ships.—An outstanding lesson of Jellicoe's story of the Grand Fleet is that it is men, not material, that win battles. The supposed great superiority of the British fleet over the Germans in the North Sea simply did not exist, at least in the earlier stages of the war, when the German High Seas Fleet consisted of 15 battleships and four battle-cruisers, and the British Grand Fleet of 17 battleships and five battle-cruisers. The British excess in battleships was offset by the fact that Germany had between 80 and 90 destroyers to Great Britain's 42. These figures apply only to the North Sea, where the total German strength was concentrated and where a part only of the British fleet was present.

Last Year's Shipbuilding Output.—Outside of Germany and Austria-Hungary, the shipyards of the whole world during 1918 produced 5,477,444 gross tons of merchant shipping, as given in the Annual Summary of Lloyd's Register of Shipping. This is 63 per cent higher than the total in the year 1913, which held the record for construction and included the output of Germany, Austria, etc. The total for the United Kingdom in 1918 was 1,348,120 gross tons and the output for the United States was 3,033,030 gross tons, which is equal to that for the ten years 1907 to 1916 in the United States, and half of this was built on the Pacific Coast. Of the United States total output of 3,033,030 tons, about 1,000,000 consisted of wooden ships.

Science

An Ornithological Robbery.—Dr. W. J. Holland, director of the Carnegie Museum, announces that a shipment of birds collected for the museum by S. M. Klages in French Guiana and Brazil was broken into and robbed of a large part of its contents on its arrival in New York city early in February. Purchasers of ornithological specimens are warned to be on the lookout for the stolen property.

A Service of Eugenic Advice.—The Eugenics Record Office, at Cold Spring Harbor, Long Island, reports that it carries on a rapidly increasing amount of correspondence in response to requests for advice concerning the eugenical fitness of proposed marriages. Most inquiries grow out of two situations; viz., (1) contemplated cousin matings, and (2) the marriage of persons in one or both of whose families there is a neuropathic taint. Persons making requests for advice along these lines are always required to prepare family-history data according to instructions given by the Office. Eugenical advice is then given, in accordance with existing knowledge of the inheritance of traits.

New Sources of Rubber in the United States.—On behalf of the Carnegie Institution of Washington, an extensive survey of the Great Basin region for rubber-producing plants was begun in the year 1917, as a war-emergency project. During 1918 this broadened into comprehensive search throughout the western United States for species known or suspected to contain rubber, and the work will be continued until the rubber-producing possibilities of the native plants, at least, have been fully investigated. A chemical laboratory has been installed for the grinding and extraction of the plant material. In addition to species of Chrysothamnus and Ericameria, the first genera studied, 18 genera and 30 species have been examined chemically, and in four of these the percentage of rubber was high enough to warrant the hope that the species may serve as a commercial source of rubber.

Weather Bureau Begins Work in Volcanology.—Under authorization of the current appropriation act for the Department of Agriculture, which provides $10,000 for investigations in volcanology, the U. S. Weather Bureau on February 15th, 1919, formally took charge of the volcanological observatory on Kilauea, Hawaiian Islands. Prof. T. A. Jaggar, Jr., formerly of the Massachusetts Institute of Technology, who has been director of the observatory since its foundation, will remain in charge. The investigations at Kilauea were begun in 1912, under the auspices of the Massachusetts Institute of Technology, and since 1913 have been maintained at the expense of the Hawaiian Volcano Research Association, consisting chiefly of residents of Honolulu. It is expected that the Weather Bureau's work in volcanology will be developed in many details and eventually be extended to Alaska and other regions under the control of the United States in which active volcanoes exist.

The International Catalog of Scientific Literature.—This important scientific bibliography is normally published in 17 volumes per annum, each volume being devoted to a separate branch of science. The last annual report of the United States bureau of this undertaking, situated at the Smithsonian Institution, calls attention to some of the difficulties that have arisen in consequence of the war. Six of the regional bureaus—viz., Germany, Austria, Hungary, Poland, Belgium and Russia—are in arrears with their contributions to the extent of nearly $9,000 per annum, and it will be necessary to obtain a subsidy from some source to finance the fifteenth annual issue of the catalog, as was done in connection with the fourteenth issue, for which grants were obtained from the Royal Society of London and the Carnegie Foundation of New York. It is especially interesting to learn that the work of indexing the literature published in the countries whose regional bureaus have closed has been carried on largely by the central bureau, in London, where already 15,000 reference cards have been prepared for the German literature of 1915. The central bureau could continue to index German literature, in case Germany is excluded from coöperation in the enterprise in years to come. It has been proposed to broaden the scope of the catalog by including the literature of various technical industries, instead of limiting the work to pure science.

Electricity

Improved Lightning Discharges.—According to the *Revue Générale de l'Electricité*, a French patent has been taken out for a new form of lightning discharger of the vacuum type. The new principle consists in using a radioactive salt (radium chloride is suggested) to furnish the necessary ions in the tube to produce an instantaneous discharge across the gap; in this way, it is claimed, the time lag between the application of the excess voltage and the discharge is materially lessened.

Resumption of Amateur Wireless.—All restrictions upon the use of radio receiving stations other than those used for commercial traffic were removed on April 15th last. The order, which was announced by Acting Secretary Roosevelt of the Navy Department, applies to amateur, technical, experimental, and other stations. The restrictions on transmitters, however, remain in effect for the time being.

Radium Indicators for Switches and Pull Chains.—Among the latest novelties in the electrical equipment field are the luminous pendants, buttons, and thumb tacks for indicating the position of a switch or pull-chain socket in the dark. These pendants, buttons, and thumb tacks are treated with a radium compound which emits a steady glow in the dark, and which does not become exhausted for many years. Aside from serving to indicate the location of electric switches and pendants, these luminous indicators can be used for indicating the edge of a table, chair, piano, or other piece of furniture.

Peat Excavating by Electricity.—The efficient digging out of peat practically necessitates some form of excavating machinery, and it is interesting to observe that, according to the London *Electrician*, an electrically-driven appliance of this kind has been in use in Holland for over 20 years. It consists of a strong frame supporting several vertical bars terminating in steel knives, and also buckets, into which the peat, when cut out, is deposited. The machine is driven by an electric motor. It is possible to cut 1,100 cubic yards of peat per day of 10 hours, which is equivalent to about 350 tons of dry peat. The machine can be propelled forward on rails laid on the surface of the peat, or, when the water-level is near the surface, on the deck of a raft.

Electric Precipitation of Particles from Waste Gas.—An interesting development in the electric method of depositing solid materials in suspension from waste gases is recorded in the *Electrical World*. In a copper-refining plant in the east, the Cottrell process of electric precipitation has been applied to remove 90 per cent of solid and liquid particles in suspension in flue gases, and it is estimated that within quite a short period the amount of copper and zinc reclaimed will pay for the equipment. The discharge takes place at 100,000 volts and 0.5 ampere, and the transformers used have tappings at 50, 62, 75, and 87 per cent of full voltage. Another example of a similar process is given in *American Gas Engineering*, which summarizes the work of Dr. J. D. Davidson on the treatment of coke-oven gas. In this case also particles are precipitated by an electrical method, an important feature being the removal of tar, which has always been a source of trouble.

Wireless Equipment of the "George Washington."—The steamer which has been carrying President Wilson back and forth between the United States and Europe is no doubt the best equipped ship afloat as regards radio equipment. Indeed, it has been referred to as a floating laboratory for wireless experimentation and research. The radio equipment on the first trip with the President consisted of one low-power spark transmitter, one 16,900 meter long-wave receiving set, one short-wave 600-meter receiving set for spark signals, one short-range radio telephone transmitting and receiving set, one vacuum-tube 450-meter transmitting and receiving set. The escorting battleship, "Pennsylvania," received messages transmitted from the high powered stations at Annapolis, New Brunswick, and Tuckerton in the United States, and Lyons, France, intended for the President, and relayed them by the vacuum-tube and radio telephone sets simultaneously. Messages from the President destined to the United States or France were sent from the "George Washington" to the "Pennsylvania" by the vacuum-tube or radio telephone set, and relayed by the battleship's 30-kilowatt arc transmitter.

An Airman's Story

As Told to C. H. Claudy, Special Correspondent of the SCIENTIFIC AMERICAN in France

HE was an American, although he wore a British airman's uniform. He walked with a crutch and a limp, and his face was queer, as might be expected of a face that had smashed into wreckage and looked at death through a 10,000-foot drop and then watched the ceiling in a military hospital for several months.

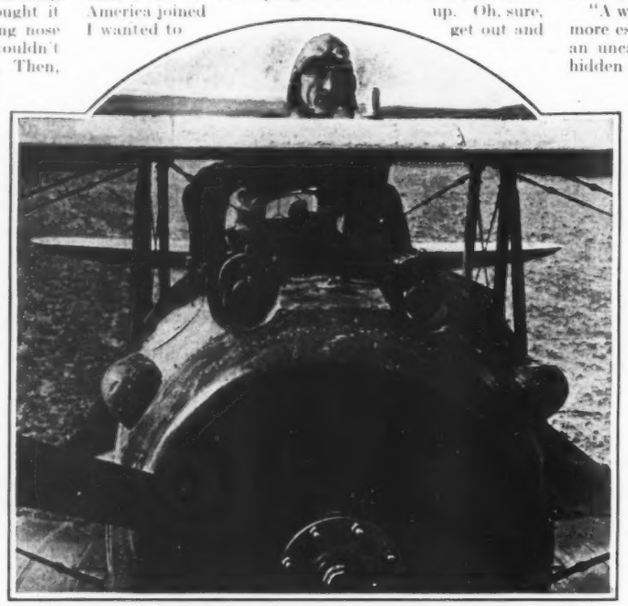
". . . had my tail shot off at 10,000 feet. Yes, Archie did it. Archie didn't do much damage most of the time, but when he did land he landed with both feet. Having your tail shot off isn't pleasant, especially when you don't know it. I had been chasing a Boche and I was just about ready to give him what was coming to him—gunner had just opened fire, when something happened. It sounded like a dull thud. I thought it was the motor. Then I dropped into a spinning nose dive and when I pulled to bring her out of it she wouldn't come—just went right on hunting Mother Earth. Then, I looked around and managed to see enough, or rather not to see enough, to know I didn't have any tail left. Yes, somewhat exciting. Ten thousand feet is a fairly long drop. Oh, no, you don't get going faster and faster; a nose dive is just so fast after a few hundred feet or so but its amply fast enough! I didn't see much hope for me or Buddie with the gun. Now of course you won't believe it—I don't myself—but it's a solemn fact that I wasn't a bit scared. I sort of felt I wasn't born to die that way and while I didn't have the slightest notion as to what was going to save me from messing up the landscape and getting to look like something the cat had brought in, I did feel that something was going to prevent a personal tragedy. It sounds like real good American 'bull,' too, to say I was more anxious on Buddie's account than mine, especially since I've a girl and Buddie hasn't. But I was.

"Well, we kept right on spinning and the landscape came right on up to meet us, and I was dizzy, what with the roads and the river and the blotches which might be houses or camions or most anything spinning around in that mad sort of way. It seemed a mighty long time. I suppose it was a minute and a half, maybe. Then all of a sudden, there was the earth about a hundred feet away and I knew if I was going to do anything it was do it right then or I'd be out of luck and pushing daisies up through the sod in a day or so! And it's funny, because I've been flying for almost three years, but I can't remember for the life of me which wing I tipped. I remember realizing that maybe if I could land on a wing instead of my nose I'd be better off, and so I lifted one of them as hard as I could. Then I remember a great crash, which was absolutely without any pain whatever, and the next thing I knew some one was saying, 'He'll do now' and there was a nurse wiping what was left of my face.

"I was all splints and bandages—ankle busted, knee broken, two fingers and three ribs busted, face cut open and with two prize spots on my body that were *not* black and blue. But outside of being all stove in that way and feeling like one large ache, I was all right. Buddie was all right, too. He's still in hospital and apt to stay there; for he had two broken legs and both arms smashed and was hurt inside, too, but he's going to come out some day.

"So I'm to go home. No, I won't fly any more, so they say. In fact, there isn't going to be any more war flying, so they say. Never mind that. I was in luck to have seen so much.

"What did we do? We Americans? Well, you ought to know what the Americans did in the air line better than I do. I was flying in a British uniform before America joined up. Oh, sure, I wanted to get out and get in under the Stars and Stripes, but those things only happen in books. England had invested a lot of money in training me, and I guess she had a right to all I had to give. Anyway, I gave it.



Eddie Rickenbacker, the famous American Ace

"Of course, all of us regular U. S. A. chaps felt sore as a boil that the U. S. didn't get more planes and men into the game. The men were splendid—regular fellows, all of them. All the British flying people think the American airman is a dandy. They swear by "Rick," you know. We—I mean they—think the Liberty motor is all right, although they have a big fellow of their own which is some punkins of a motor. But they haven't so much to say about the American plane. I don't know just how much of this is some one's fault and how much something that couldn't be helped. I've talked with a lot of us Americans in Uncle Sam's khaki about the trouble with the American plane.

"You know they picked the D. H. to put into quantity production. Well, it didn't seem to hold up. If it smashed it just fairly splintered. There are two answers: One is a forced seasoning of the wood; spruce which has been seasoned in a hurry hasn't the strength of spruce which is naturally seasoned. The other answer is that machine production of wooden parts leaves out the human element. Inspection doesn't seem to reach the difficulty.

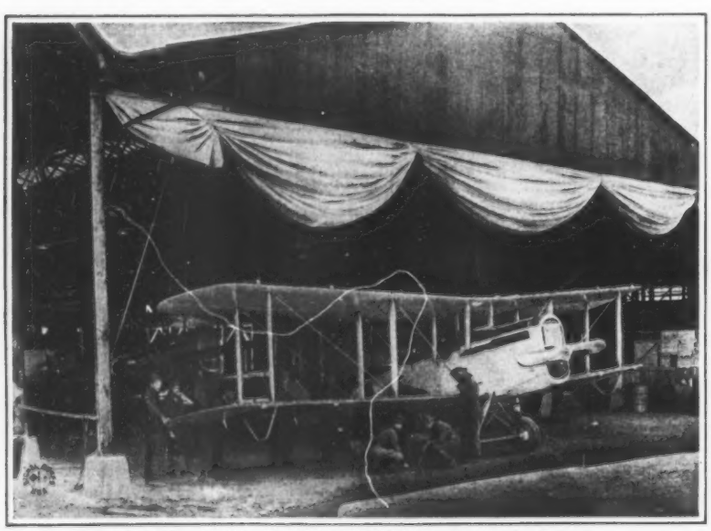
"A workman who fits all his wooden parts by hand, and more especially if he is a seasoned, skilled workman, gets an uncanny ability to tell good wood from bad. The hidden flaw he detects, somehow. The inspector can't, no matter how good he is. So there were a lot of chaps who were out of luck in American D. H. planes who ought to be flying now—at least, that's the way it seems to the American flyers in American uniforms. Personally, I am morally sure that if it had been a quantity production plane I'd dropped ten thousand feet in, just landing on the wing tip wouldn't have saved me. I'd be six feet under with the boys painting up a headboard for me.

"Sure, I know this sort of thing doesn't get published. Heaven knows I'm not knocking any one. I like the British lads fine and I've been a member of the family in fact, just as well as in uniform. They don't say much, but they soon let you know whether you belong or not. I belonged, and I'm proud of it. But I'm Yankee all through, and don't you forget it, and I'm not getting out any hammers for Uncle Sam. But facts are facts and you can't cover 'em with brush and paint and get away with it. And so when I see a lot of whitewashing done about American participation in the air work over here, it sort of makes me mad, not at, but for my country.

"Oh, it's natural enough for any one connected with the service to want to make the very best showing he can. But—well, I took the trouble to collect a little information as to just what we, U. S. A. that means, had actually done at the front, as to machines and men engaged. I got my facts from the flying men, no office statistics about this, and you can call them gospel truth or German propaganda lies, whichever you choose. Don't forget it's a Yank in this uniform talking, will you? All right. Here's what the U. S. had at the front.

"I suppose you know there were 20 pilots in a squadron? Well, at the armistice the Americans had 12 pursuit squadrons. They had one observation group of three squadrons. There was one day-bombing squadron and there we stopped! Of course we had night bombers, but they are included in that first two-

(*Continued on page 440*)



A Liberty airplane ready for the field, Romorantin, France

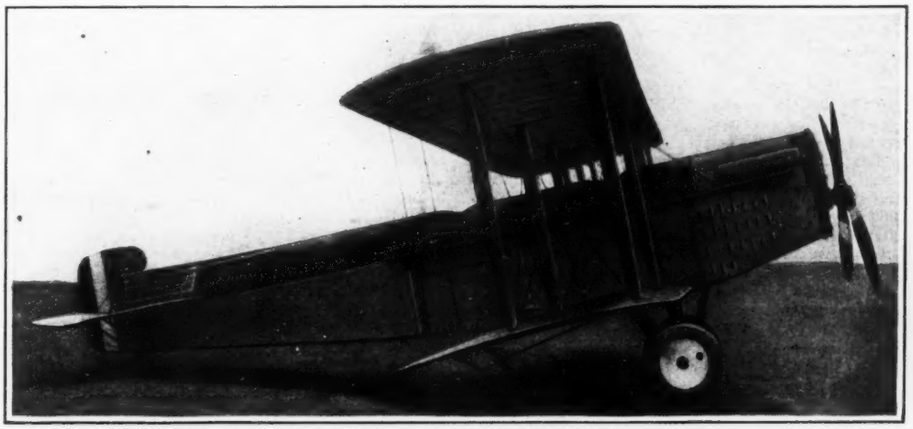
An escadrille of airplanes at Toul, France

Small Airplanes and the Trans-Atlantic Flight

Describing the Sopwith, Short, and Martynside Airplanes Entered in the Great Contest

THE coming trans-Atlantic flight has taken a queer turn. Only yesterday, everyone in and out of aeronautical affairs was expectantly waiting to see a line up of giant planes, such as the Handley-Page, Caproni, Farman "Goliath," and our large Naval machines. Surely, no one would attempt the flight with a single engine; for has it not long been patent in aeronautical contests that even the best engine is apt to fail at the critical moment? Yet at the moment of writing we are on the eve of one or more attempts with comparatively small, two-seater biplanes, equipped with a single engine. Truly, it is a great surprise.

There has been no dearth of airmen willing to attempt the great trans-Atlantic flight. Indeed, the number of contestants already far exceeds expectations; and because of the growing certainty that the flight will be achieved in short order, the contest is fast developing into a race with the chances largely in favor of the first one to start. Thus it has come about that, while most airmen and constructors have been leisurely going about planning and building huge, multi-engined planes with every safeguard against a total failure, intrepid British aviators have stolen a march on practically everyone by getting small, two-seater machines to the starting point, ready to depart at almost any moment. It may be that these aviators are taking a gambler's chance with the possibilities of engine failure and forced landing; it may be that one, two, or the three of them will fail in their attempt; but after giving the entire matter considerable thought it would seem that they stand an excellent chance of succeeding before this reaches the reader.



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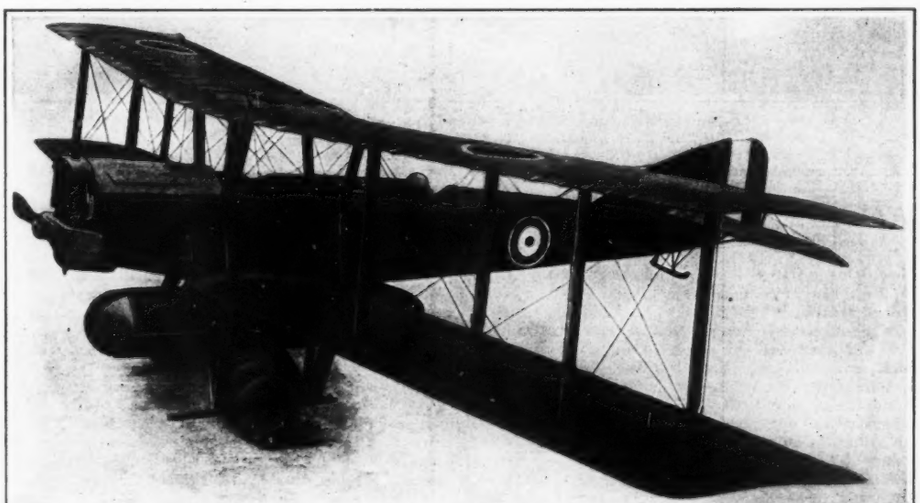
The trans-Atlantic Sopwith biplane with special fuselage fairing forming a boat

The three small planes referred to are the Sopwith, to be flown by Harry G. Hawker and Lieut.-Com. Grieve; the Martynside, which will be the mount of Frederick Philip Raynham; and the Short, manned by Major Wood and Captain Wyllis. The first two are starting from Newfoundland, while the latter is starting from Ireland.

The Sopwith machine weighs, fully loaded, about 6,100 pounds, and carries 300 gallons of gasoline. It is equipped with a Rolls-Roye "Eagle" engine, developing 400 horse-power. In a recent test before the machine left England, it covered a distance of 900 miles in nine hours and five minutes, 146 gallons of fuel being consumed. This constitutes more than a third of the capacity of the tanks. It will be noted from the accompanying illustration that the Sopwith biplane is very similar to the American Curtiss training plane in general design. However, it is a far more powerful machine, and considerably heavier. The fairing of the fuselage has been so constructed that it forms a boat sufficiently large to support both pilot and navigator for some considerable time, should a forced descent have to be made on the surface. The landing wheels and supporting struts, forming the landing gear, are so attached that they can be released at will. Thus the airmen plan to release their landing gear during the earlier part of their journey, in order to reduce the head resistance and gain some six or seven miles additional speed. This procedure, however, will necessitate "crashing" when the aviators wish to alight; but Hawker has already landed without wheels during extensive test flights and seems quite confident of his proposed move, which virtually amounts to burning his bridges behind him.

The close competitor of the Sopwith, namely, the Martynside, is very similar in appearance to the Sopwith. In fact, it is more or less like the famous Martynside F-4, a machine of a type which was never used on active service, although a year before the end of the war it was by some miles per hour the fastest, as well as being the highest-climbing, airplane in the world. Fully loaded, the trans-Atlantic 41-foot span Martynside weighs about 5,000 pounds, and carries 360 gallons of gasoline. The cruising capacity with a 20-mile wind against it all the way is easily over 2,000 miles. However, the airmen do not expect to encounter adverse winds for any great stretch, and, indeed, they are counting on favorable winds to increase their speed. In calm air the Martynside makes about 125 miles an hour, as compared with about 106 for the Sopwith after dropping its landing gear. It is equipped with a Rolls-Royce "Falcon" engine of 280 horse-power. This machine does not carry a lifeboat, but the airmen are to be kept warm by electrically-heated asbestos foot warmers and gloves. A wireless receiving set is being carried for receiving radio position reports from nearby ships.



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The trans-Atlantic Short biplane, with special tank below fuselage

Meanwhile the Short biplane, on the soil of Ireland, is waiting to start. It is of the type known as the "land bomber." It has been fitted with larger gasoline tanks and a wireless apparatus, after the removal of the former war equipment. In fact, the work of preparing it was rushed to the utmost in order that it might be among the first to start. Like the Sopwith, it is equipped with a Rolls-Royce engine of 400 horse-power. It has a span of 51 feet 6 inches, and weighs about 8,000 pounds fully loaded. The only unusual feature of the machine is a large torpedo-shaped gasoline tank which is fitted beneath the fuselage. This tank can be emptied quickly, and will have sufficient buoyancy to keep the airplane afloat if a forced descent is made on the surface.

The Growth of Ellis Island

AN interesting piece of engineering work is being done at Ellis Island, the port through which immigrants enter New York. The island really consists of three parts, only one of which constitutes the original island, and that has been greatly extended. The growth of the island is shown in our title page illustration, where in the upper left-hand corner may be seen the area of the original island and its extension in 1890. Later two other islands were built to the southwest of the first one. On Island No. 2 are the hospital buildings and on Island No. 3 are the wards for patients suffering contagious diseases. The original island known as "Oyster Island" was barely four acres in extent. It now covers 10 acres and will soon be extended to over 16 acres. The basin between Islands No. 2 and No. 3 will be filled in and the whole area of Ellis Island will then cover more than 28 acres or seven times the area of the original island. The extension is shown in the upper right-hand corner of the title page illustration.

Between the main island and Island No. 2 there is a ferry basin enclosed by a seawall which originally was built on crib work. Every year this waterway has to be dredged out to get rid of accumulations of sediment, and this constant dredging has had the effect of undermining the crib work so that the walks bordering the seawalls recently began to sag and break away, with the probability that before long the whole wall would topple over into the water. To remedy this condition, it was decided to build new seawalls of concrete, reaching down to such a depth that they could not possibly be undermined by dredging. The work on these walls is now proceeding.

The new walls are built of huge concrete blocks just outside the crib work walls. First a trench is dredged in which are laid bags of concrete. These on hardening form a good foundation for the wall. In order to furnish the concrete blocks with a level bed to rest on railroad rails are placed at either side of the bag work foundation and the space between them is filled with concrete deposited by means of bottom dumping buckets. Before placing the concrete, divers caulk up any openings between the rails and the bag work by means of long narrow bags filled with concrete. The concrete fill is smoothed off by means of divers, who lay a rail across the marginal rails and slide it along the foundation. In this way the concrete is leveled off very nicely. Whenever the divers find a pocket that needs filling, they signal to the surface for a bucket of concrete to fill the cavity.

After the floor has set, the concrete blocks are laid upon it. These are huge masses of concrete, 17 feet high and 12 feet wide, measuring nine feet thick at the bottom and five feet two inches at the top. They weigh about 87 tons apiece. The process of lowering them into position and adjusting them properly on the foundation is no simple one. In order to handle the blocks, chain grooves are formed in them and when the chains are removed, slots 12 inches in diameter are

(Continued on page 442)

Emergency Employment Committee for Soldiers and Sailors

Stopping the Breach Caused by the Curtailment of Funds of the United States Employment Service

By D. M. Reynolds, U. S. Council of National Defense

THE United States Council of National Defense, through an Emergency Employment Committee representing all branches of the Government, has taken over the problem of finding employment for soldiers and sailors—work that became necessary because of the lack of funds available in the U. S. Employment Service. This need became apparent when on March 13th the Department of Labor issued the following statement:

"Owing to the failure of the passage of the Urgent Deficiency bill and the unavailability of funds from other sources, the U. S. Employment Service, the national machine for placing soldiers, sailors and war workers in suitable employment, will be reduced to 20 per cent of its present size on March 22d."

This simple announcement meant that the U. S. Employment Service, which during the first ten months of 1918 had taken out of peace-time pursuits over two and a quarter million men and women and placed them in industries manufacturing supplies and ammunition for our armies at home and abroad, which, since the signing of the armistice had been placing in suitable employment an average of 100,000 men and women a week—must immediately reduce its machinery from 750 branch offices to approximately 56, and its personnel from nearly 5,000 employees to 1,000.

By March 14th the Council of National Defense announced the formation of an emergency committee to find employment for soldiers and sailors with Colonel Arthur Woods as chairman.

On the same day a telegram was sent to the Governors of each state and the mayors of a large number of principal cities asking for cooperation. Almost immediately telegrams began to pour in both to the Council of National Defense and the U. S. Employment Service from governors, mayors, organizations and private individuals, containing pledges of support and advices of immediate action tending to support the Federal Employment Service, until on March 22d, John B. Densmore, Director General of the U. S. Employment Service was able to issue a statement in which he said:

"In addition to the 56 offices which the Federal Employment Service had arranged to continue, approximately 250 more—nearly half the total number slated for closing today—are assured of continuance for the Employment Service by contributed funds and personal services. . . . The 2,000 Emergency Bureaus for Returning Soldiers and Sailors and the activities of the U. S. Employment Service in the demobilization camps and on the transports will also be continued at full blast. The pledges of outside funds to keep the service going until Congress assembles, from the treasuries of states, cities, chambers of commerce, labor and welfare organizations and other volunteer bodies already amount to hundreds of thousands."

The welcome which the inter-departmental committee, known as the Emergency Employment Committee—representing as it does all branches of the government which are interested in the problems of labor and employment—received from the press and the country at large, has demonstrated clearly the need for some such organization to act in a purely administrative capacity, and place behind the Federal Employment Service at least for the present emergency the full strength of all governmental machinery.

The personnel of the committee is satisfying and compeling. The records for performance of its individual members guarantee the carrying out of any task to which it sets itself.

In selecting Col. Arthur Woods as his special assistant in employment matters and to act as chairman of this committee, the Secretary of War has picked a man whose reputation for efficiency, integrity and inspiration is nation-wide.

A New York newspaper man in describing him said: "He was the best Police Commissioner New York ever had." Mention his name to a New Yorker and the reply almost instantly is, "Oh, you mean the Police Commissioner."

The position of Police Commissioner of New York city has been the grave of many a shining reputation, and destroyed forever the hopes and aspirations of more than one incorruptible man. Woods' success was due solely to his policy of the square deal in its broadest sense. His first announcement was: "Any patrolman can see me personally, at any time and talk over his troubles, but the patrolman's friends can never see me." He lived up to this policy to the letter, which meant the immediate abolition of politics in the department. The effect on the morale of New York's 10,000 policemen was incalculable, and he left the police force the finest and best disciplined body of uniformed men in the world.

It will not be any part of the work of the Emergency Employment Committee to create, maintain or operate under its own administration, any employment machinery to substitute that which already exists.

Its first duty is to gather the fullest information concerning all existing agencies, whether governmental or established and maintained by private organizations and individuals, study their efficiency and find out just how the War Department and the committee can, by cooperating with the local agencies, fulfill the nation's obligation to the men which it is now returning to civil life.

Its second duty is to find out how the government and the Emergency Employment Committee can best supplement and support the work of the U. S. Employment Service, and encourage cities and towns, through public and private contributions to carry on the bureaus for returning soldiers and sailors, and to establish similar bureaus where they do not exist.

Its third and perhaps one of its most important functions will be to determine to the fullest extent, the needs of the discharged soldier, sailor and marine, and how best needs can be supplied. To do this work, plans have already been made for a very complete division of information. It will be the task of this division to establish a personal contact between the man and the department of the government with which he may have to deal. It has been proposed that this work shall be so complete that this branch will be able to answer any question regarding the status in civil life of the man leaving the service.

The Emergency Employment Committee has already received pledges of support and cooperation from all the great welfare organizations, from Chambers of commerce all over the United States, from many of the great trade and manufacturers organizations and other sources.

The organization of this committee and the work which it already has under way is complete evidence of a full measure of realization on the part of the government that its obligation to the individual does not cease when he is discharged from the service.

The instant response by the country to the preliminary appeal, is clearly indicative that the nation—to paraphrase Victor T. J. Gannon, writing for "Carry-On"—is going to fight for him today, as he fought for us yesterday, that his tomorrow may be worthy of us both.

Seated, left to right—Mathew Woll, American Federation of Labor; Elliott Goodwin, General Secretary, Chamber of Commerce of the United States; John W. Hollowell; Edward N. Hurley, Chairman United States Shipping Board; Colonel Arthur Woods, Chairman of the Committee; Grosvenor B. Clarkson, Director of the Council of National Defense; Franklin D. Roosevelt, Acting Secretary of the Navy; Nathan A. Smyth, Assistant Director General, United States Employment Service; E. J. Ayers, Interior Department. *Standing, left to right*—Assistant Secretary Christie, Department of Agriculture; D. M. Reynolds, Assistant to the Director, U. S. Council National Defense; E. H. Greenwood, Secretary of the Committee; B. S. Cutler, Chief, Bureau of Foreign and Domestic Commerce; Dr. R. McElwee.

United States Council of National Defense's Emergency Employment Committee for Soldiers and Sailors

The Current Supplement

FROM time to time articles on the so-called "flying sickness" have appeared in the newspapers and magazines. It has usually been suggested that this sickness hinged upon a failure of the human mechanism properly to adjust itself to the change in pressure involved in passing from high altitudes to low or *vice versa*, and that accordingly it was in a way analogous to "bends" and other caisson afflictions. That this is utterly fallacious is the thesis of the author of *Flying Sickness*, in the current SUPPLEMENT, No. 2260, for April 26th; and an excellent case is made for what this experienced aviator regards as the true cause of the malady. In the chemical field is presented a translation of Professor Mouredo's recent address upon *Inorganic Complexes*, in which much of interest alike to chemist and to layman is said. *Water Power in California* discusses the position which this state occupies in the present and potential development of this factor in fuel conservation. *Degrees of Permanence in Photographic Prints* makes plain what can be done in this direction and how, and what cannot be done and why not. The amateur will find it instructive, and the professional will have to admit that at the very least it is interesting. An excellent account of the latest development in mechanical handling of materials is given in *The Portable Scoop Conveyor*. An investigator into the mysteries of crystal growth contributes an admirable description of his *Apparatus for Growing Crystals Under Control*. *The History of the Cattle-Tick Fight* tells what the Government has done to eradicate this dangerous pest, and the measure of success that has crowned the efforts. The story of *Radio Telephony* runs through its second installment, and will be concluded in a third part next week. In addition, various shorter articles of value will be found.

Composition of the Atmosphere of the Soil

FROM 10 to 20 per cent by volume of the soil is composed of air, but this "atmosphere of the soil" differs from the superficial atmosphere in composition and is likewise more variable. The percentages of its constituents vary likewise from season to season. Recent investigations of this subject by two English scientists, Messrs. Russel and Appleyard at Rothamstead in England furnish some interesting data. To a depth of 0,15 meter the soil atmosphere is very similar to that of ordinary air, though containing a little more carbon dioxide, but the total amount of carbon dioxide plus oxygen is less than in the air. During periods of active nitrification the percentage of oxygen diminishes, and this is one of the conditions which characterizes the so-called "awakening" of the earth in spring.

Besides the atmosphere entangled in the interstices of the soil there is a certain amount of air dissolved in the water and the colloids the soil contains, but this is almost entirely deprived of oxygen.

From November to May the curves follow the temperature, but from May to November the percentage of oxygen in the atmosphere of the soil increases with every rain-fall (as does bacterial activity), which proves that the soil-atmosphere is renewed by the rain. This fact indicates that rain is superior to irrigation. As might be expected soil which is covered with turf contains more carbon dioxide and less oxygen than arable earth. The composition of the soil-atmosphere appears to be but slightly affected by variations in barometric pressure, by temperature, by velocity of the wind, or by crop conditions.

Supplying the British Farmer with the Sinews of War

How Inadequate Supplies of Labor, Machinery, Seed and Fertilizer Were Stretched into Sufficiency

By Major H. Bannerman-Phillips

THE problems of administrative organization of the means for increased food production, and of a sufficient land supply for the carrying out of the program, have been discussed in a previous article, in which it was shown how they have been solved. After this, the main concerns have been to secure an adequate supply of labor, to increase and properly mobilize the supply of horses and agricultural machinery, and to obtain and distribute a sufficiency of seed and fertilizer.

In July, 1914, it was estimated that in Great Britain the number of men regularly employed in agriculture was 800,000, while the number of women was 80,000; and that, in addition, 120,000 men and 50,000 women were employed at casual agricultural labor. By January, 1917, the number of men had fallen to 562,000; and as there then remained in agriculture 177,000 men of military age and 118,000 under 18 years old, it appeared that additional large numbers would have to be lost. Further inquiry had brought out the fact that the system of voluntary recruiting on the one hand, and the action of local tribunals on the other, had resulted in an unequal distribution of farm labor. So far as was possible, efforts were made to rectify this inequality by limiting the demands of the War Office to particular areas. Owing, however, to the urgency of reserving labor for carrying out the extended tillage program, it was finally decided in June, 1917, that no agricultural labor might be recruited in Great Britain by the War Office except with the consent of the Agricultural Executive Committees in England and Wales or of the Board of Agriculture for Scotland. Meanwhile, the War Office had taken steps to assist the Boards of Agriculture in England and Scotland by placing at the disposal of the Executive Committees a considerable number of skilled plowmen and a still larger number of unskilled workers. In the spring of 1917, 21,000 plowmen and 19,000 other laborers were lent for agricultural work in England and Wales. The bulk of the skilled plowmen were lent only for eight weeks, but their assistance proved invaluable in carrying out the spring tillage. In Scotland also 1,850 men were loaned from the army to assist in the spring cultivation. During the year, also, the War Office provided labor to assist at the hay and corn harvests, and close on 40,000 men have been made available in England and Wales and 3,000 in Scotland. The War Cabinet also decided at the end of June that provision should be made during the summer for the release, for agricultural operations during the season of 1917-18, 25,000 men experienced in agriculture or used to horses and 25,000 unskilled men. Up to the middle of December about 35,000 men had been made available.

In addition to the supply of military labor, special efforts were made to secure the help of women as workers on the land. An active recruiting campaign was undertaken, and provision was made for training workers by means of short courses at colleges, institutes, and on the farms. Complete returns of the number of women employed in agriculture are not available, but it is estimated that 270,000 women are now employed as permanent or temporary farm hands. This expansion is largely due to the work of the voluntary organization of the Women's War Agricultural Committees, Village Registrars and District representatives, and has been greatly helped by the appointment of group leaders with technical knowledge, who have organized gangs of part-time village workers all over England. Women have proved in farm work, as in munitions and in many other occupations, how great is the service they can render to their country in war-time. Squads, also, of boy labor from public and secondary schools of the country were organized in vacation and have contributed to the successful results of last summer. In addition to these supplies of home labor, 4,500 German prisoners have been employed in connection with agricultural work.

The second requirement for the program of increased tillage was the provision of additional mechanical power for the service of agriculture as well as an increase in the number of horses. Steps were promptly taken to mobilize the existing supply of tractors and steam plows and to provide for an increased supply at the earliest possible date. This task was the more difficult because, on the one hand, almost all the agricultural implement makers had been engaged on the manufacture of munitions, while, on the other hand, the importing capacity from America was limited. The suitability of different types of tractors was carefully tested, and finally it was decided to concentrate the main effort on the American machine, the specifications for which were generously placed by Mr. Henry Ford, of Detroit, at the disposal of the British Government. It had been intended originally to manufacture these tractors in the United Kingdom, but it was found more speedy delivery would result if they were made in and shipped from the United States. Delivery commenced on January, 1918, on a program calling for 4,000 machines in four months; and orders given for other makes insured that 7,000 Government tractors of one type or another, with plows and other tractor implements, would be available to assist in work for the 1918 harvest in Great Britain and Ireland.

Another important factor is the use of steam plowing tackle. Owing to difficulties of labor and lack of repairing facilities, the steam plowing tackle in this country at the beginning of 1917 was not being used nearly as effectively as it should have been. These difficulties were largely overcome by the release from the army of men experienced in steam tackle work and by arrangements for repairs, so that at present all the sets of tackle in this country are being put to effective use. By the beginning of October, 1917, the efficiency of the steam plowing plant, as measured by work done, had increased by 65 per cent over what it had been in the period of spring tillage. Arrangements had also been made through the Ministry of Munitions for as many new sets

(Continued on page 442)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Dynamite and Fertilizing

To the Editor of the SCIENTIFIC AMERICAN:

An article appearing in your issue of February 8th under the head of "Dynamiting Devastated Orchards in France," etc., has attracted my attention because a French Horticultural authority has laid before the French Academy a paper making claim that dynamite was an important factor in aiding the fertility of orchard soils, "due partly to the fissurization of the soil, and partly to the impregnation of the soil with nitrogenous subjects." He makes mention of the fact that the dynamite is to be used "in conjunction with a suitable amount of fertilizer in a container surrounding the explosive in such a way that the force of the explosion would drive the former into the fissures produced by the explosion." The very fact that dynamite contains two of the most important and active fertilizing agents, to wit, nitrate and sulfur, makes it unnecessary to go any further in aiding the fertilization by blasting, than to just *use the dynamite alone.*

In the use of any supplemental fertilizer surrounding a dynamite charge, there is an effect that the advocates of that method seem to lose view of, dynamite in detonation generates an intense heat, and though the force action is almost instantaneous the heat is as quick, the fertilizer surrounding the dynamite charge in the soil is partially burned, and its benefit then must occur from its change to the vapor containing gases, that pass out through the soil, and is exactly the same method that the dynamite alone produces plus the mechanical action of widely opening the soil to the gases that follow.

The first use of dynamite in aiding the fertility of the soil is on record as having been made in Austria. The growers of both deciduous and citrus fruits on the Pacific Slope and Coast have made use of dynamite in orchards for many years, and where soil conditions are such that a benefit can be realized, that benefit is wonderfully manifest in the growth of the tree and the quality of the fruit thereof. This knowledge is not so new a thing, when it is remembered that its first record of use bears the date of 1876, or thereabout. That it has not been widely adopted is due to the fact that in some cases it has been improperly used, and its benefits even go further than giving a return to a young or new orchard; it will revive old trees where the work is properly done, in a manner that is marvelous.

It is to be borne in mind that the greatest benefit realized from blasted orchard soils follows where the blasting is done at the very driest period of the year: "fissurization" is then the greatest, thus fitting the soil for the widest possible benefits from the blasting.

The question arises, "How does the dynamite become a fertilizer?" Something over 70 per cent of nearly all high explosives is nitrate and sulfur. When these are changed from solids to a gas, through explosion in the soil, the gas given off passing out through the fissures made, produce an oxidation that has an affinity for the free nitrogen of the air, and the blasted soil acquires thereby from the atmosphere a larger portion of that seven tons of free nitrogen, said to overlie every square yard of the earth's surface, therefore, the soil is enriched. It has been the observation of the writer that the effects of blasting are visible for a number of years, in better growth of the tree, and a higher quality of fruit. The blasts give best result when placed at a depth of 48 inches to 54 inches.

J. H. WILLMAN.

Seattle, Wash.

The Fertilizer Cartridge

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of February 8th, the writer noted with much interest the description of an idea much the same as one employed by me, in a cartridge containing fertilizers and dynamite. The ultimate aim of this cartridge is for soil enrichment, medication and inoculation, and seeking to supply a balanced ration in keeping with its needs, by analysis, I have but taken advantage of a situation already set, the separate use of dynamite and the very successful use of fertilizers on the surface. This makes an expeditious and direct way of feeding, or the treating of trees for their ills through the circulation.

A. J. AVERELL.

Medford, Ore.

A Great Piece of Executive Work

To the Editor of the SCIENTIFIC AMERICAN:

I was interested in reading an article in a recent issue of SCIENTIFIC AMERICAN on Edgewood Arsenal, Maryland.

We are interested in this article because of the fact that we designed and supervised the construction and operation of the chlorine plant which was built at Edgewood and were entirely responsible for all of this work.

I wish to state that your comments on the work of Col. William H. Walker do not really do him justice. Colonel Walker took hold of Edgewood Arsenal when it was in a most chaotic condition and straightened all matters out, and he got the personnel working as one unit. He did the greatest piece of executive work that I have ever had the pleasure of being associated with.

SAMUEL M. GREEN.

Springfield, Mass.

The Automatic Shovel

To the Editor of the SCIENTIFIC AMERICAN:

In your publication of February 22d, an inquiry is published from W. E. Abbott, Murrulen Wingen, N. S. W. in regard to "a digging machine to be operated by the weight of the engine."

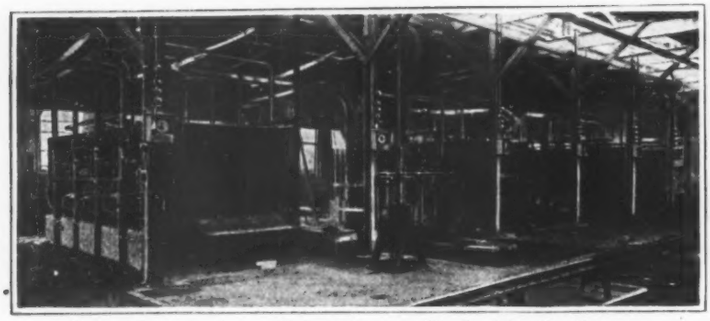
Before this war I remember having read a description in one of the technical monthlies published in Bohemia of a similar machine of a Swiss invention, operating on the same principle of weight of the engine; it works very successfully and a revolution in cultivation of lands has been promised by this machine.

On a great cylinder, similar to those used on some tractors as a back-wheel, a row of spades are attached adjustable to any desired depth to dig in the soil, the weight of the whole machine forcing these spades in the ground and automatically turning it over by the forward movement of the machine. I never noticed anything on this continent of such an invention and it may be interesting to the farm implement manufacturers to investigate and construct machines of such action.

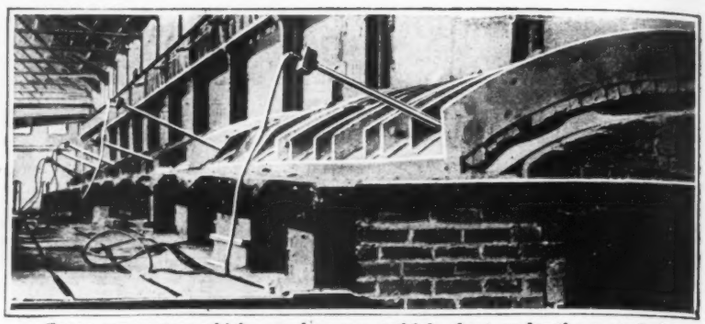
It was claimed that such a machine works faster and better than any other plowing outfit for great or small farms.

AUG. FIBIGER.

Winnipeg, Man.



Automatic pyrometers and signal lamps on the heat-treating furnaces in a steel mill



Seven pyrometers which record on one multiple chart, under the control of a single operator who works in a quiet office

Weighing High Temperatures in an Electric Balance

A New System of Pyrometry that Gives Better Control of Heat Processes

By J. M. Bird

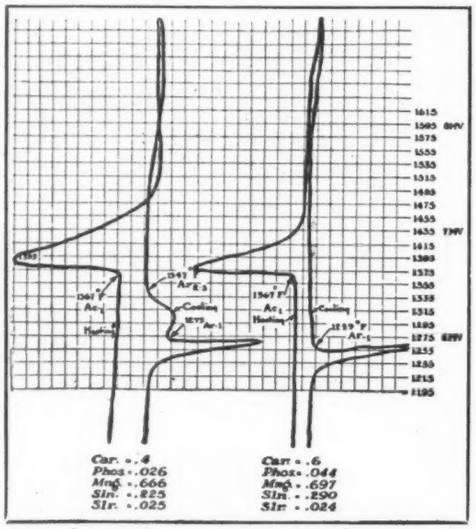
THE manufacture of munitions has brought about a great extension in the practice of heat-treating metals, which in turn has resulted in rapid development of that art. In particular, it has been demonstrated that a prerequisite to success is ability to gage with accuracy the temperatures employed. Consequently, much attention has been devoted to the instrument which, to distinguish it from the thermometer in its ability to measure temperatures running up into the hundreds and even thousands of degrees, is given the special name pyrometer.

The thermocouple has come into almost universal use in this connection, so that a pyrometer which employs any other means of measurement is today a rarity. A thermocouple, it may be necessary to state, consists of two pieces of dissimilar metals joined at both extremities. For no reason which can be made very clear, an electromotive force is set up at these two junctions; the existence of this force is best accepted, without argument as to the whys and wherefores. And, as seems eminently reasonable, it is in opposite senses at the opposite junctions, so that the two forces oppose one another in the circuit formed by the two pieces.

Under normal circumstances, of course, nothing happens. The two forces are equal and opposite; they balance off exactly, and there is no current through the couple. But it happens that the force generated at either junction varies with the temperature at that junction. Accordingly, when the two junctions are at different temperatures, the two forces do not balance off exactly, but one of them neutralizes the other and leaves something over; and we at once have a current in the circuit. This current can be measured; and when measured, its voltage gives us the difference of potential between the two junctions. But when we know the difference of potential, we know the difference in temperature; and if then we know the temperature of one junction, we know that of the other. So we have our pyrometer.

Electromotive force may be measured by the strength of the current it produces. A coil or winding included in the circuit is suspended near a permanent magnet in such way that the coil or the magnet can move under the influence of the magnetic force set up by the current flowing through the coil. But the force then exerted depends upon several factors—the electromotive force set up at the hot and at the cold junction, the resistance of the circuit (including the thermocouple, the lead-wires and the galvanometer coil), and the strength of the magnetic field. Moreover, this force is usually measured by permitting it to twist or bend a spring included in the suspension; and the displacement then depends upon the peculiarities and the condition of the spring quite as much as upon the force itself.

Changes in any of these factors will affect the result. So it is necessary, when using this method, to provide a constant cold-junction temperature. This can be done by means of a steam box, an insulating jacket, or by burying the cold junction deep in the earth—which is not as inconvenient as it sounds, when we consider that

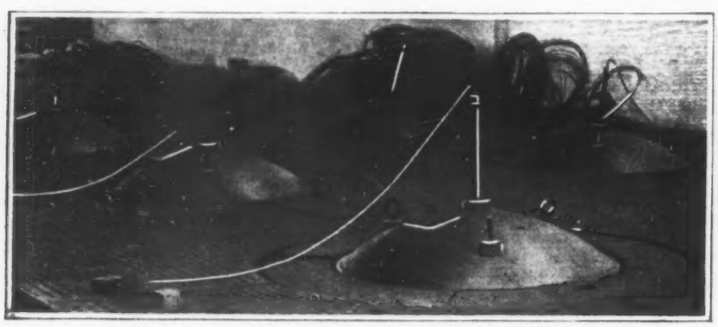


Curves for transformation points of two different steels, showing in each case the heating curve and the cooling curve

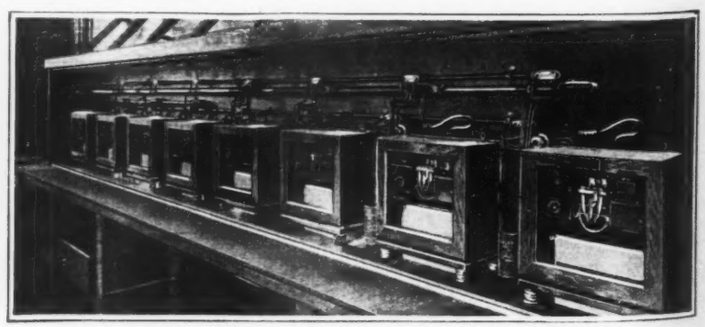
the two elements of the thermocouple are frequently wires of indefinite length, joined at the ends. It is necessary, also, to eliminate the effects of changes in the resistance of the thermocouple and the lead-wires by using a galvanometer of high resistance, which would swallow up any changes in the low resistance mentioned; and it is necessary to guard against physical changes in the galvanometers themselves by frequent calibration. But unfortunately, high resistance in the galvanometer necessarily implies small current, and correspondingly small power available for the operation of the instrument; in other words, greatly increased delicacy and liability to derangement.

An alternative to this series of complications is afforded in a recently developed system of temperature control, using the potentiometer. This instrument is the electrical equivalent of the weighing balance. With balance scales, measurements are made by applying variable known weights until they equal the unknown weight. When this occurs, the scales stand at zero, the position which they occupy when there is no weight in either pan; they are then said to be balanced. In quite the same fashion, measurements are made with the potentiometer by balancing a known electromotive force against the unknown; when they are equal, the index of the instrument, a galvanometer needle, stands motionless as it is alternately thrown into and out of the circuit. In the case of the weighing scales, the variable known weights are external units, separate from the scales; the potentiometer provides its own variable known electromotive force to balance against the unknown.

Our drawing shows the wiring of the potentiometer in its simplest form. The thermocouple is at H, with polarity as shown by the symbols. It is connected with the main circuit of the potentiometer at the fixed point D and the movable point G. A current from the dry cell Ba is constantly flowing through the circuit RBCDGEFA. The section DGE of this circuit is a slide wire, uniform in resistance throughout its length. The flowing current undergoes a fall in potential as it passes from D toward E, so that there is a difference in voltage, or an electromotive force, between D and E. There will similarly be an electromotive force between D and every intermediate point of the wire. The polarity of this force is in opposition to that of the thermocouple which connects into the potentiometer at D and at G—in words of one syllable, these two currents flow in opposite directions. By moving G along the slide wire a point is found where the voltage between D and G in the slide wire is just equal to that between D and G generated by the thermocouple. The galvanometer in the thermocouple circuit indicates when the balance point is reached, since at this point the needle will stand motionless when its circuit is opened and closed. To return to our words of one syllable, the currents flowing in opposite directions are now exactly equal, so they exactly counteract one another, and the net result is zero. By previous calibration, the difference in potential between D and G is known for all positions of G; and hence it is known what force has



Pyrometer equipment on a heat-treatment furnace of a different type



The recording apparatus that controls the steel-furnace installation shown at the top of the page

been introduced into the circuit HDGH to offset the force created in the thermocouple.

When we apply the potentiometer to the thermocouple, the galvanometer, instead of measuring the actual electromotive force, is used merely as a current detector to show when there is no current flowing—that is, when the balance or opposition is complete. Thus, at one stroke all concern as to small and accidental changes in the resistance of the thermocouple, or of the lead-wires, or of the galvanometer, or as to the strength of the magnetic field or the spring tension of the galvanometer, are eliminated; none of these items has any effect whatever upon the accuracy of the instrument.

As the length and the resistance of the lead-wires do not matter, many different thermocouples can be measured at one central station by one operator and one potentiometer, regardless of the distances separating the couples from the central station. Moreover, inexpensive base-metal thermocouples can be used instead of the costly platinum couples; for while the resistance of the base-metal couples is not so constant as that of platinum couples, their constancy of electromotive force at a given temperature—the fundamental property upon which pyrometry is based—is quite as great. Then, with base-metal couples, the lead wires can be made of

(Continued on page 442)

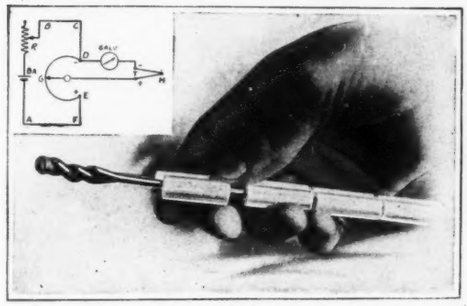
A New Process for Drying Food

THE arguments in favor of dehydration of food products are all in, and it is to be assumed that they are now sufficiently familiar to us all to make superfluous their repetition here. The verdict seems to be that dehydration has come to stay, and that its very general use waits merely upon the development of the necessary machines and the necessary readjustment of the channels of commercial distribution of food.

The first of these items is the one which has received the most attention, because it naturally comes first. The intangible mechanism of distribution is not going to be modified to give the drier a source of supply of green foods and a market for his waterless product until the tangible machinery for doing the drying is on a basis which will attract capital. We have already described in these columns at least two installations for removing the moisture from fresh vegetables; and we have pointed out that the one was the logical outcome of the other. In the first, air was passed over the material at a temperature sufficient to bring about drying. In the second, the progressive principle of operation was added to make the process more rapid, more effective and more complete; and we pointed out at the time that this was an improvement which would go far toward putting dehydration upon a level of commercial success.

A group of investigators at Columbia University, headed by Prof. Ralph H. McKee, has been at work for some months on a drying system which marks a branching out in an entirely new direction. The idea behind this undertaking is that the use of the air current should be abandoned altogether, and the drying carried out in vacuo, by the agency of heat alone. It was confidently believed from the start that this mode of operation, if it could be worked out on a practical scale at all, would yield a process applicable to meats as well as to vegetables and even to juicy products like tomatoes, which one would hesitate to dry by use of the air current system.

One of the advantages to be derived from successful execution of this idea would be a greater measure of cleanliness; if we are not going to pass a current of air over our food, we are at once discharged from all concern as to the germ content of that air. Then, too, the air-current system can be a real success only when carried on progressively, and this implies that the material under treatment is advanced from one chamber to another at the various stages of the process. Accordingly we get away from a lot of mechanical complications when we take up a process which involves merely putting the raw material in one place and leaving it there until its treatment is completed. Moreover, it is now possible to carry out the whole process under uniform conditions; so we have only one set of conditions to study and regulate, instead of many such sets. And since we have replaced the principle of the air current by the principle of a vacuum, we have eliminated the condition of humidity, substituting for it the condition of pressure; and the latter is much more easily regulated than the former—especially when it is necessary to make the former variable.



A thermocouple of base metals. The insert shows the wiring scheme for the potentiometer

The work of Dr. McKee and his associates would have been materially simplified had they been content to attack the problems of vegetable drying alone. But they were eager, as already suggested, to extend their methods to the drying of meat and fish; and this introduced some very special and very trying complications.

Vacuum-dried meat, and the water that came out of it

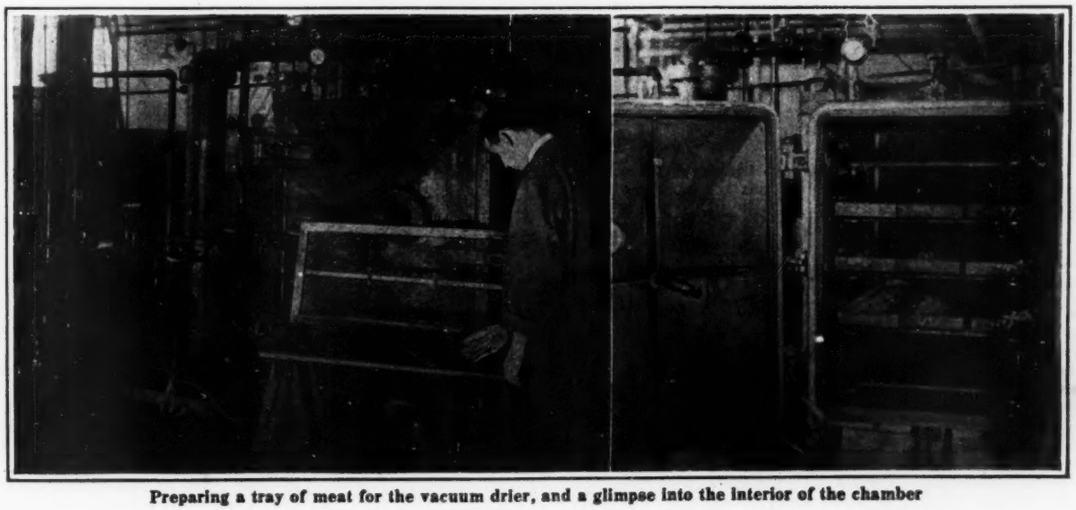
What one of these is can be seen by considering the case of a hard-boiled egg. If dried meat is to score any conspicuous success, we must be able to say of it, as we have so often said of vegetables dried by one process or another, that the cellular structure is unimpaired; that with the absorption of water, the dried product becomes again just like the fresh, and, when cooked and eaten, looks and tastes and smells just like the fresh.

Now when an egg is boiled hard, the albumen becomes permanently coagulated; its cellular structure is changed. It can never again masquerade as a fresh egg; it can never be poached or fried or boiled soft or have any of the other things done to it that are done to fresh eggs. Similarly in meat and fish there is a large albumen content; and if we simply put the meat or fish in a vacuum and turn on the heat, without paying any heed to details, we shall find, when we take off the lid and look at the results of our cooking, that the albumen has coagulated and the whole structure of our material changed. It might be good to eat in this changed state; but it would never make steak or chops or roast or even stew. It would be an entirely new product, just as a hard-boiled egg would be a new product to a man who had never eaten an egg in any other condition than raw. And civilized communities do not change their habits of diet overnight; they do not want new food products, they want the good old ones with which they are familiar.

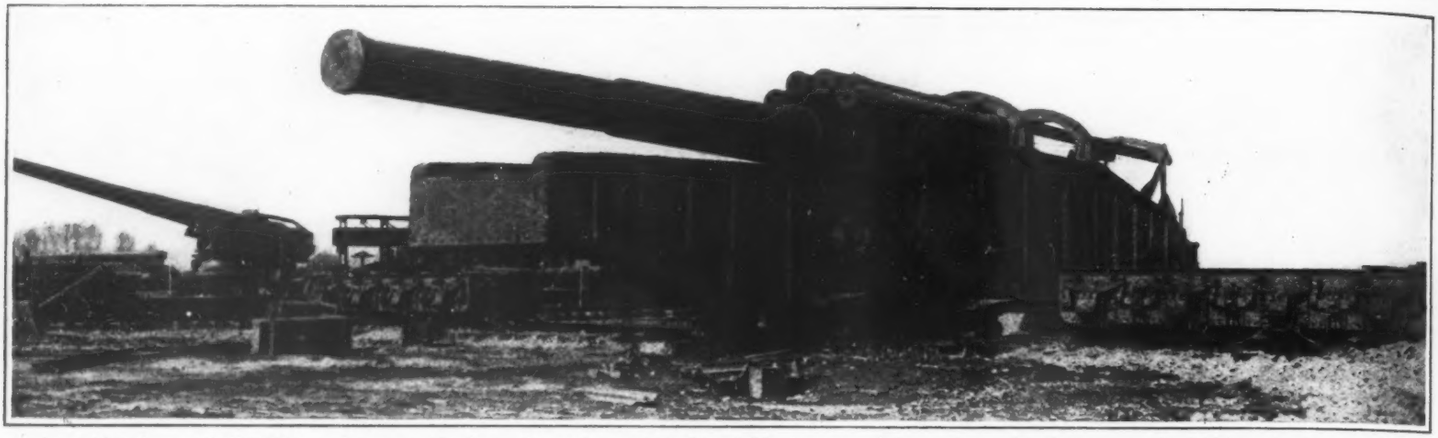
A second difficulty has to do with another fundamental component of the meat. It was found in an early stage of the experiments that in one respect vacuum drying was far superior to air drying, alike for meats and for vegetables. The long-continued hot-air current carries off the water, according to schedule; it also carries off a good part of something else—the precious vitamines, about which we talk so much nowadays and know so little beyond the mere fact that their presence is necessary to avoid scurvy and other diseases. The new method does not destroy the vitamines, but if, to compensate for this advantage, it were to fry out the fats from the meat to which it is applied, the net gain would be a small one. So we must devise some means to prevent it from frying out the fats; and this is not easy.

Before the vacuum drying process can be considered as even on the road to success, these two conditions must be met. We must find some way to regulate the temperature and the degree of vacuum so that the albumens will not coagulate and the fat will not fry out. Their patent business is not yet in a state which would warrant the Columbia chemists in telling just how they have met these demands; but they have met them. They show us pieces of meat, about the size of the chunks in an ordinary Irish stew, from which every trace of water has been eliminated, but which aside from their dryness are obviously raw meat, with a streak of lean and a streak of fat, just as Nature made them. They point out that some of these pieces are cut with the grain and some across it, indicating that it makes no difference how the material is cut. They will show tomatoes which are at the most casual glance tomatoes, minus all moisture; everything is there, seeds and all; all that need be done to make them fresh tomatoes again is to soak these wrinkled and shriveled wrecks in water.

We have indicated that the details of the process cannot be made known as yet, save the very general one on which we have already dilated, that it is a vacuum process. There is one other interesting feature which can be mentioned, however. To make a vacuum requires a pump; and to run a pump requires power. One way to generate power is by means of a steam engine; and if we will run our pump by steam, we shall have exhaust steam with a lot of heat in it—enough heat, in fact, to give us all the temperature we need in our vacuum. Professor McKee's plans are all worked out for heating his material under treatment by means of a jacket employing the exhaust steam from his pump. In the small experimental machine with which he has carried out his work so far, he has not been able to put this into practice, because this apparatus is run by an electric motor, and as some one has remarked, "You don't get much exhaust steam from an electric motor." But there can be no question of the availability of this little economy, when commercial units are designed.



Preparing a tray of meat for the vacuum drier, and a glimpse into the interior of the chamber



Army 14-inch gun; shell 1,200 pounds; range, 19 miles. A massive cast-steel turntable, transported, in sections, with the gun, can be laid in seven hours. The gun and carriage are transferred from the trucks, and the gun, as here shown, is ready for firing

America's Great Effort in Ordnance—II

The New Proving Ground For Testing Army Ordnance at Aberdeen, Md.

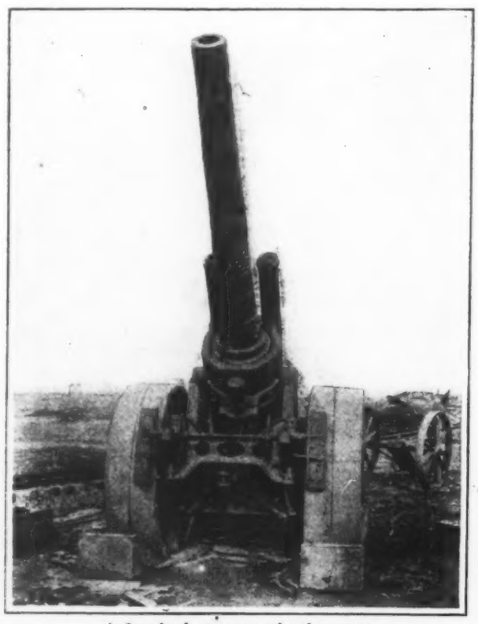
IN dealing with the production of artillery in the United States during the war, certain conditions must be kept well in mind. It should be understood, for instance, that the calibers which had been in use before we entered the war were our old type of 3-inch and 6-inch field gun. When after debate with allied commissions it was decided to use French ammunition, it was necessary, of course, to adapt the calibers of our guns to the French type of projectiles; that is to say, we had to change our 3-inch to 75 mm. bore and similarly the 6-inch to the 155 mm. It was not until August of 1917 that this decision was made; but immediately contracts were placed for many thousands of 75-mm., 155-mm. and 4.7-inch guns. Consideration also had to be given in the matter of the contracts which had been entered into by American manufacturers with the British Government, because a stoppage of work on these contracts would have meant a great handicap in the delivery of badly-needed field ordnance to the Allies.

In our first chapter of the present article (SCIENTIFIC AMERICAN, April 5th, 1919), we explained how it came about that our armies were supplied with British and French artillery. The following table shows the details of foreign purchases and the number turned over by the French and British to the American Expeditionary Force up to the time of the signing of the armistice.

3-inch Field Guns (75 mm.)	1,862
75-mm. A. A.	66
155-mm. Gun	233
155-mm. Howitzer	796
8-inch Howitzer	124
9.2-inch Howitzer	10

It should be made clear that, although in order to save shipping space and to expedite the equipment of our armies, we availed ourselves of the French and British offer to equip the first 2,000,000 men we sent over, we at once enlarged the country's facilities for the manufacture of propellants, high explosives, and every character of ordnance and placed enormous orders for the various types of field guns. The orders and acceptances of field guns were as follows:

		Ordered	Accepted
75 mm.	American	11,745	2,395
3-inch A. A.	French and British		
4.7-inch A. A.		1,597	261
155-mm. Gun		2,161	184
155-mm. Howitzer		3,000	1,579
8-inch Howitzer		295	195
240-mm. Howitzer		1,160	3



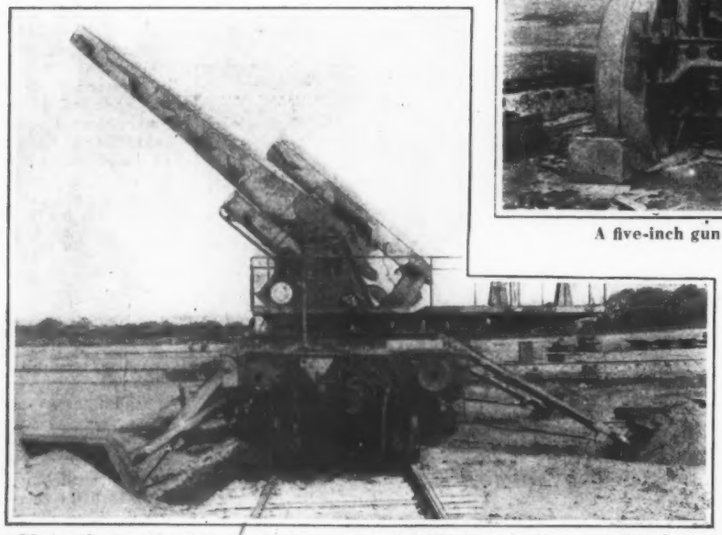
A five-inch gun on wheel mount

It is interesting to note that, figuring the elapsed time between the entrance of Great Britain into the war and an equal time factor which considers American production, United States production of mobile artillery reached Great Britain's figure in a period of 19 months. Looking at it from a different angle and considering the fact that Great Britain was already equipped with great ordnance factories, it is proved that figuring from the time of entry into war, United States production equalled that of Great Britain in a period amounting to two months less than it required Great Britain to accomplish similar results. Notice, too, should be taken of the fact that the United States furnished to Great Britain from 1915 on during the period of the war a total of 1,386 guns of calibers varying from 3-inch up to 8- and 9.2-inch. During the same period the United States also furnished Great Britain a total of 1,134 gun carriages. Incidentally, too, the United States furnished to Great Britain a total of 33,000,000 shell of various calibers from the field gun up to 12 and 15 inches.

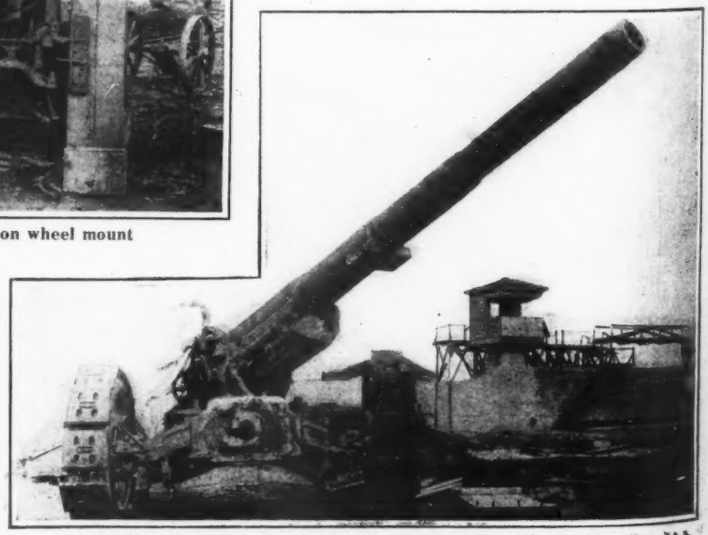
Necessity for the New Proving Ground

The necessity for the purchase and development of the great proving ground at Aberdeen was found in the fact that the famous Sandy Hook Proving Ground, established in 1874, was altogether inadequate to meet the enormous demands imposed upon us by the great war. Sandy Hook, a narrow peninsula five miles long, was and continued for many years to be fairly adequate for the ordnance of those days, when the largest gun was the 15-inch Rodman smooth bore, and rifled guns were being experimented with and high explosives and smokeless powder were unknown. Ranges were extremely moderate, judged by present day standards.

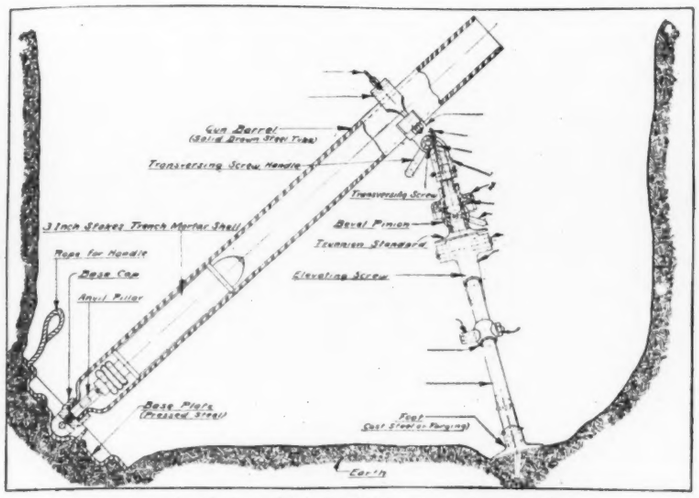
Indeed, a letter from the commanding officer, New York Arsenal, to the Chief of Ordnance in 1874, made



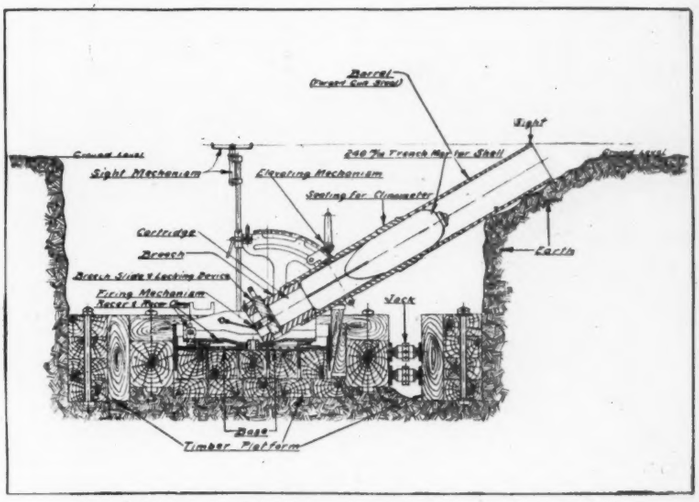
Many of our older 35-cal. 8-inch guns, good for high-angle fire, were placed on railway mounts. Note the lateral struts for steadying car against the recoil



One of the French type, 155-mm. guns on mount with split (or V) trail, which permits traverse through wide angles



Sectional view of 3-inch Stokes mortar in a trench



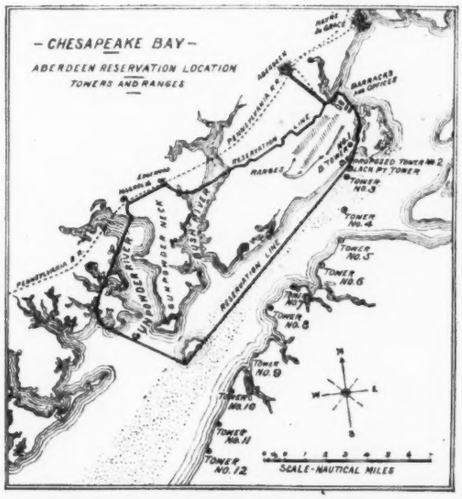
Foundations, etc., of a 240-mm. trench mortar, showing the shell

this interesting statement: "Ranges from 1,500 to 2,000 yards can be readily obtained on this reservation (Sandy Hook); and if deemed important, these distances can be considerably extended within the limits of the reservation."

The necessity for such a vast proving ground at Aberdeen will be understood if we consider the volume and diversity of the work done there. In the first place, every new type of gun, gun carriage, projectile, explosive, fuse, and a hundred other devices pertaining to ordnance, must be rigidly tested at a proving ground before it can be approved for general use. The necessity for making dangerous things safe to handle requires more prolonged and careful testing than is the case with most manufactured articles. Thus, to test a single type of gun carriage alone, 50,000 shots were fired at Aberdeen. Many thousand rounds are required to test even a single design of fuse.

Again, a sample of every lot of ordnance material manufactured must be tested to determine whether it conforms to specifications. However reliable a manufacturer may be, soldiers' lives cannot be jeopardized by allowing possibly defective ammunition to go untested. The proportion of manufactured ammunition tested is small, usually one-tenth of one per cent; but every gun and carriage must be put to the proof individually.

Thirdly, the diversity of the activities and the necessity for their freedom from dangerous interference with each other were of great importance in demanding the large area purchased, as will be shown by the summary:



Aberdeen proving ground; area, 35,000 acres; length, 15 miles. Note observation towers, on eastern shore, to plot the fall of shells

The proving ground includes a trench warfare range, where a large volume of firing at short ranges went on; a main battery, where non-explosive projectiles were fired to test powder and guns; a water range, where the splashes made by falling projectiles were accurately spotted by observers; several detonating ranges where officers watched bursting shell from bomb proofs close to the line of fire; and recovery fields where shell fired in the morning could be dug up in the afternoon. Then an aviation field with hangars and shops, a bombing field where aviators could drop explosive bombs and an anti-aircraft firing range, were needed. All these were actually provided for in the Aberdeen reservation, and Gunpowder Neck was still left for the gas plant. However, no room could be found for a firing range for testing gas shell and a new Proving Ground had to be established at Lakehurst for this purpose.

Finally, it was necessary to allow wide margins of territory for safety in view of the dangerous character of most of the activities. An anti-aircraft shell bursting at a height of 10,000 feet scatters fragments over a very considerable area, while a bursting gun or a major caliber shell striking an armor plate may project a fragment to the distance of a mile. Again, a high explosive shell may ricochet on striking the ground and be deflected far to one side of the point aimed at. While it is possible to crowd Proving Ground activities together to a dangerous degree, the lives of persons outside the grounds should be protected, and so a neutral zone must be maintained inside the boundary.

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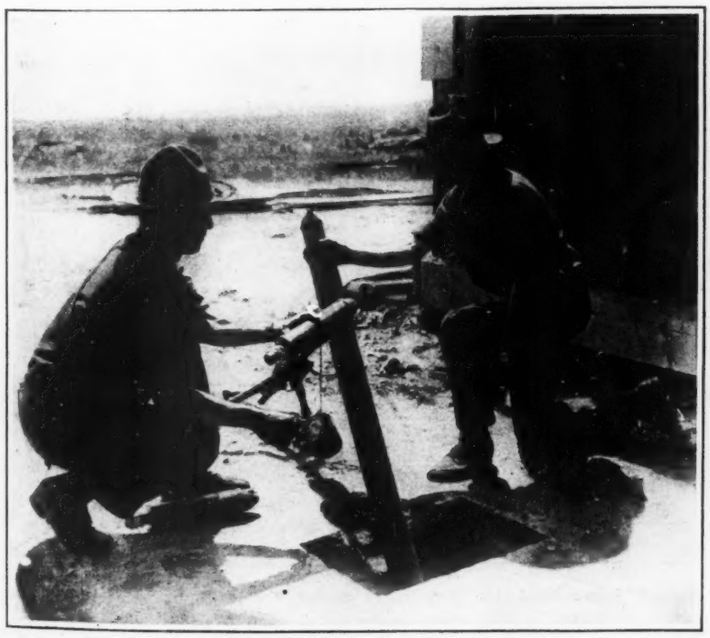
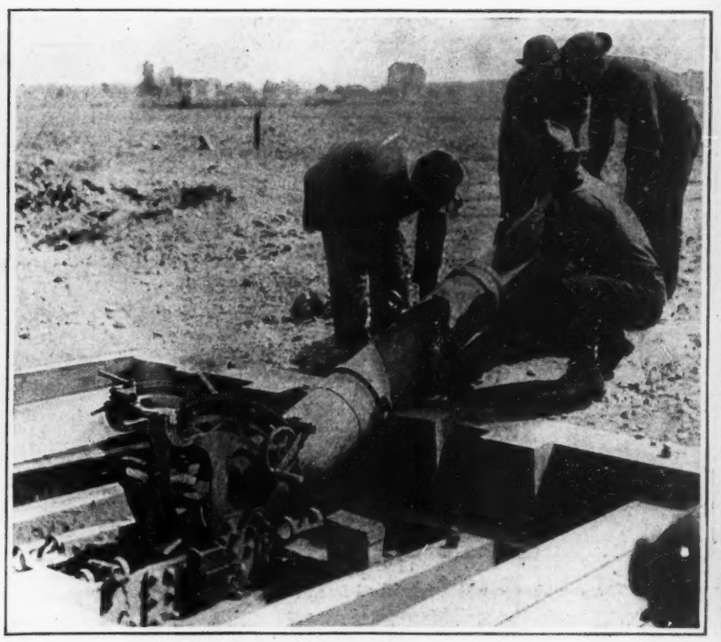
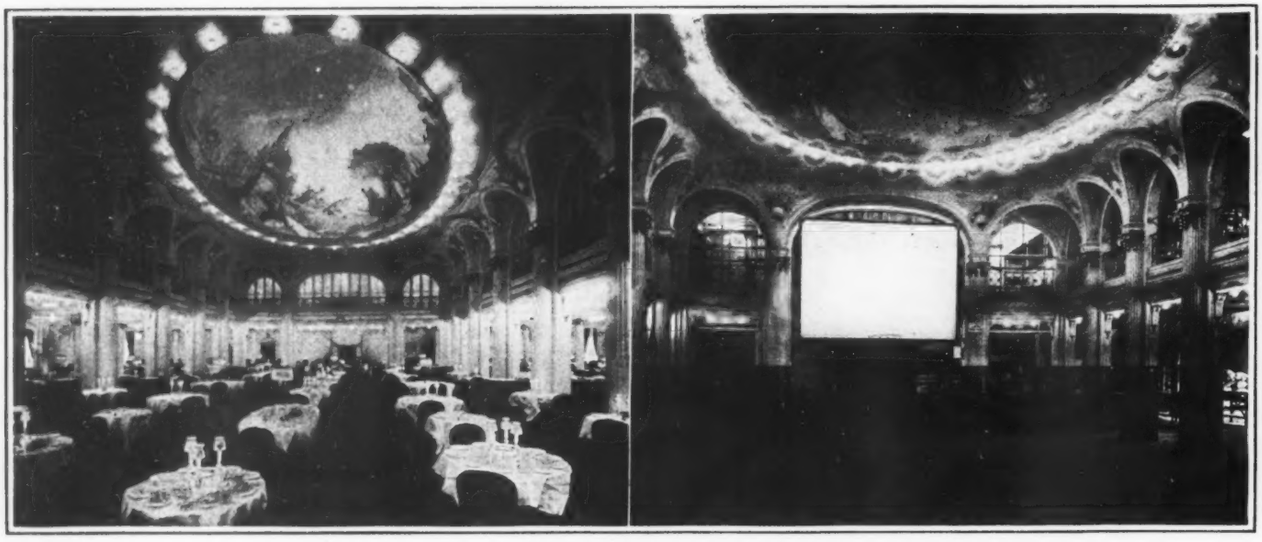


Firing 3-inch Stokes mortar by dropping the shells in at muzzle

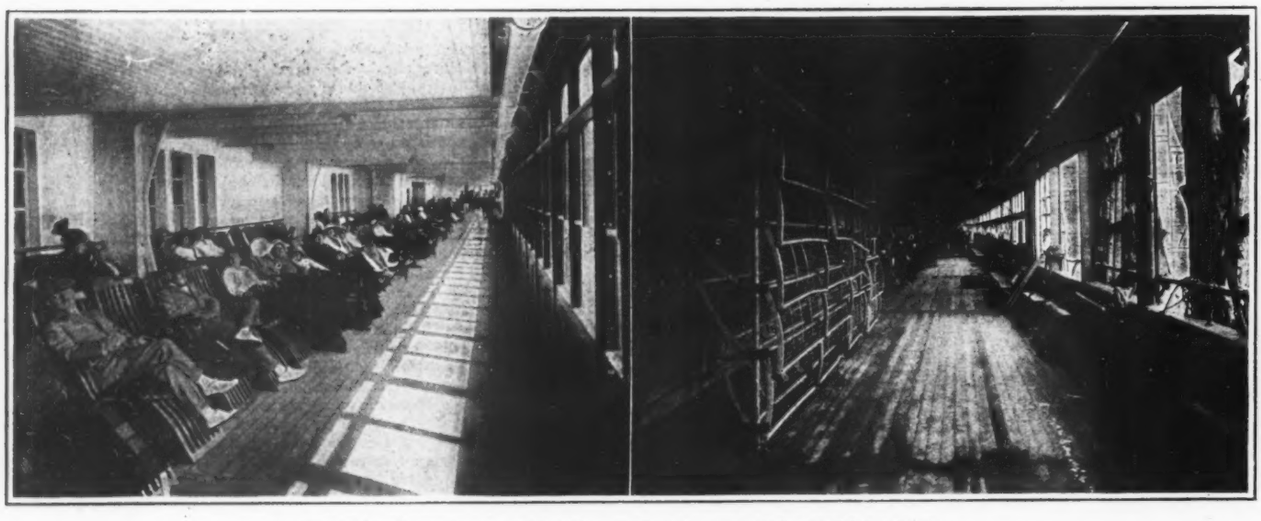


Loading the bomb into a 240-mm. trench mortar



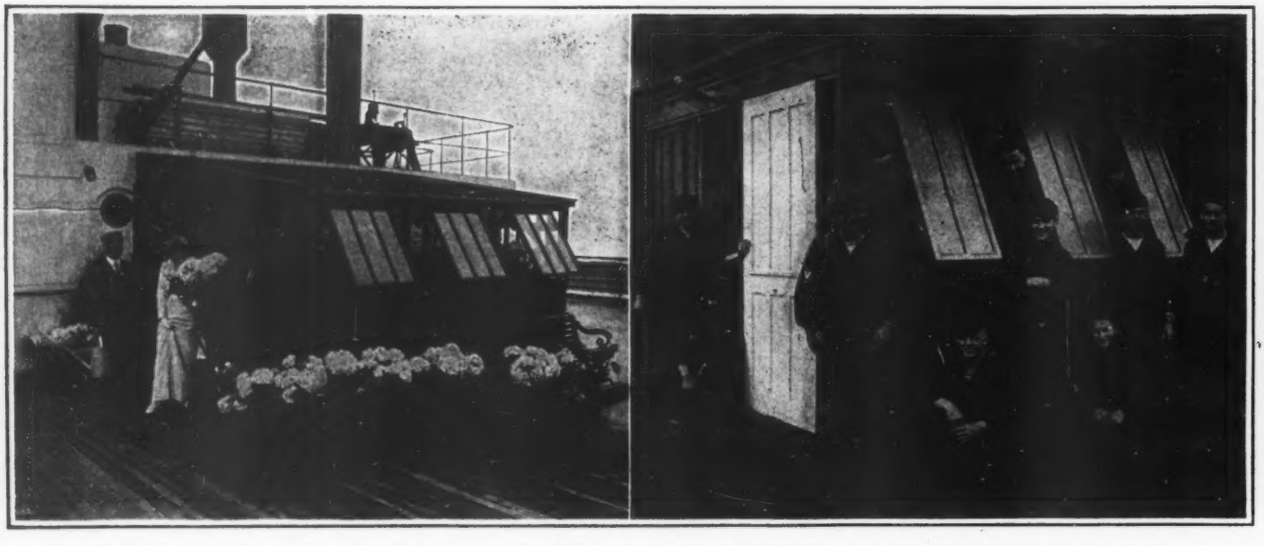
The main dining room of former days is now used as a motion-picture theater and recreation hall

The great fireplace in the smo



The enclosed promenade deck of former days is now fitted with folding bunks

The only place where the



The greenhouse which furnished fresh flowers for the dining tables of the "Vaterland" is now filled with the flower of our navy

The great fireplace now a lounge

HOW THE PALATIAL PASSENGER LINER "VATERLAND" WAS TRANSFORMED

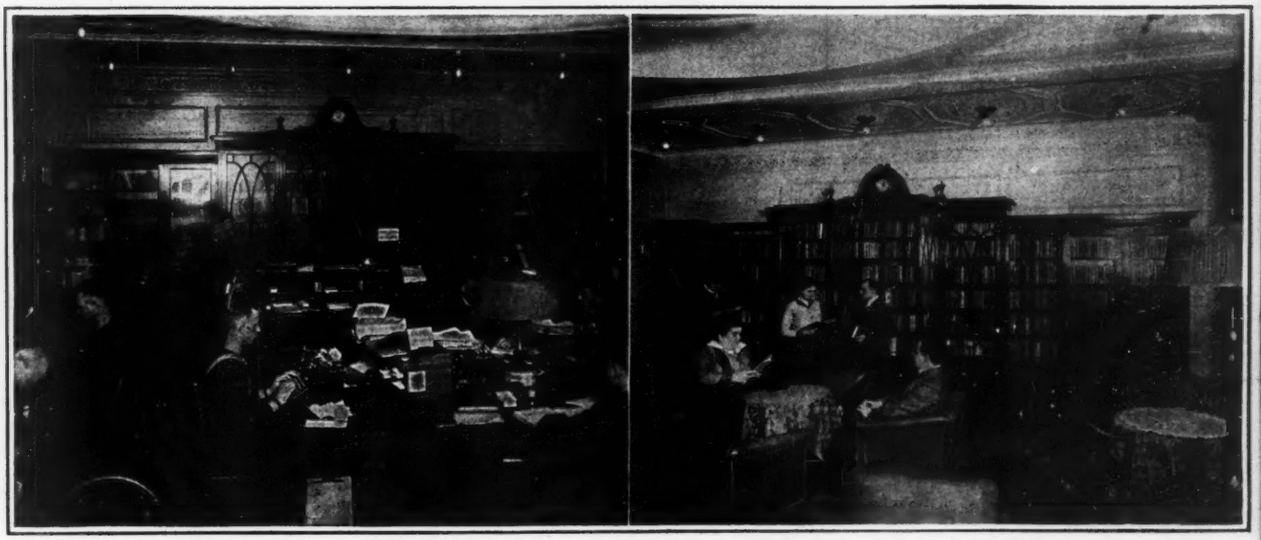
ce in the smoking room of the "Vaterland"

The officers' dining room and motion-picture theater used to be the Palm Garden Tea Room of the Ritz-Carlton Restaurant

place where the old name remains

The old swimming pool is now floored over and filled with folding bunks

lace now a lounging spot for our sailors



The busy office of the chief executive officer of the "Leviathan" used to be the "Vaterland's" library

SFORMED INTO THE HUGE TRANSPORT "LEVIATHAN" FITTED TO CARRY 12,000 MEN

What is a Man-Hour Worth in *Your* Plant?

To the worker at the machine, the value of a man-hour is one thing—to you, as his employer, it is another.

The value to him is fixed by his pay check. To you it is fixed by what he produces in that hour—and these two values must be in proper relation, one to the other.

That is why manufacturers today are busy on the problem of increasing man-hour value to them. They cannot add to the hour—they must add to the man.

How? Not by increasing his burdens, not by a driving effort, but by the one way which is logical—increasing his efficiency.

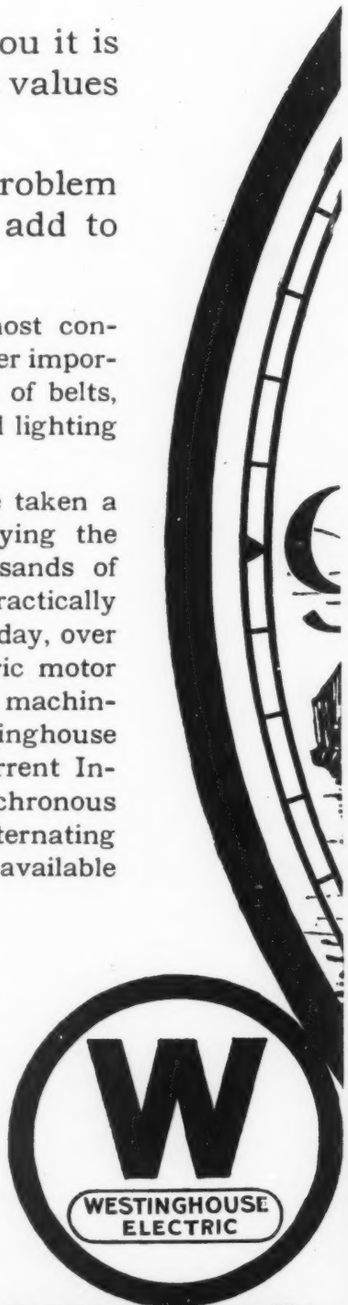
Few things are more important here than the character of the power that turns the wheels and the way this power is applied.

When electricity is harnessed to the modern machine tool, the value of the man-hour at once takes an upward bound, because electricity is the one form of power with which a lathe, a drill, a grinder or any other machine may be run swiftly for this task, slowly for that—always at a speed correct for best results. Moreover, every machine can be placed in the spot most convenient for production. Another important factor is the elimination of belts, which makes effective artificial lighting much easier.

Westinghouse Motors have taken a conspicuous part in multiplying the value of man-hours in thousands of manufacturing plants in practically every industry ever since the day, over 30 years ago, when the electric motor was first applied to industrial machinery. And not only did Westinghouse introduce the Alternating-Current Induction Motor, but the Synchronous Converter as well, so that alternating and direct current became available from the same supply line.

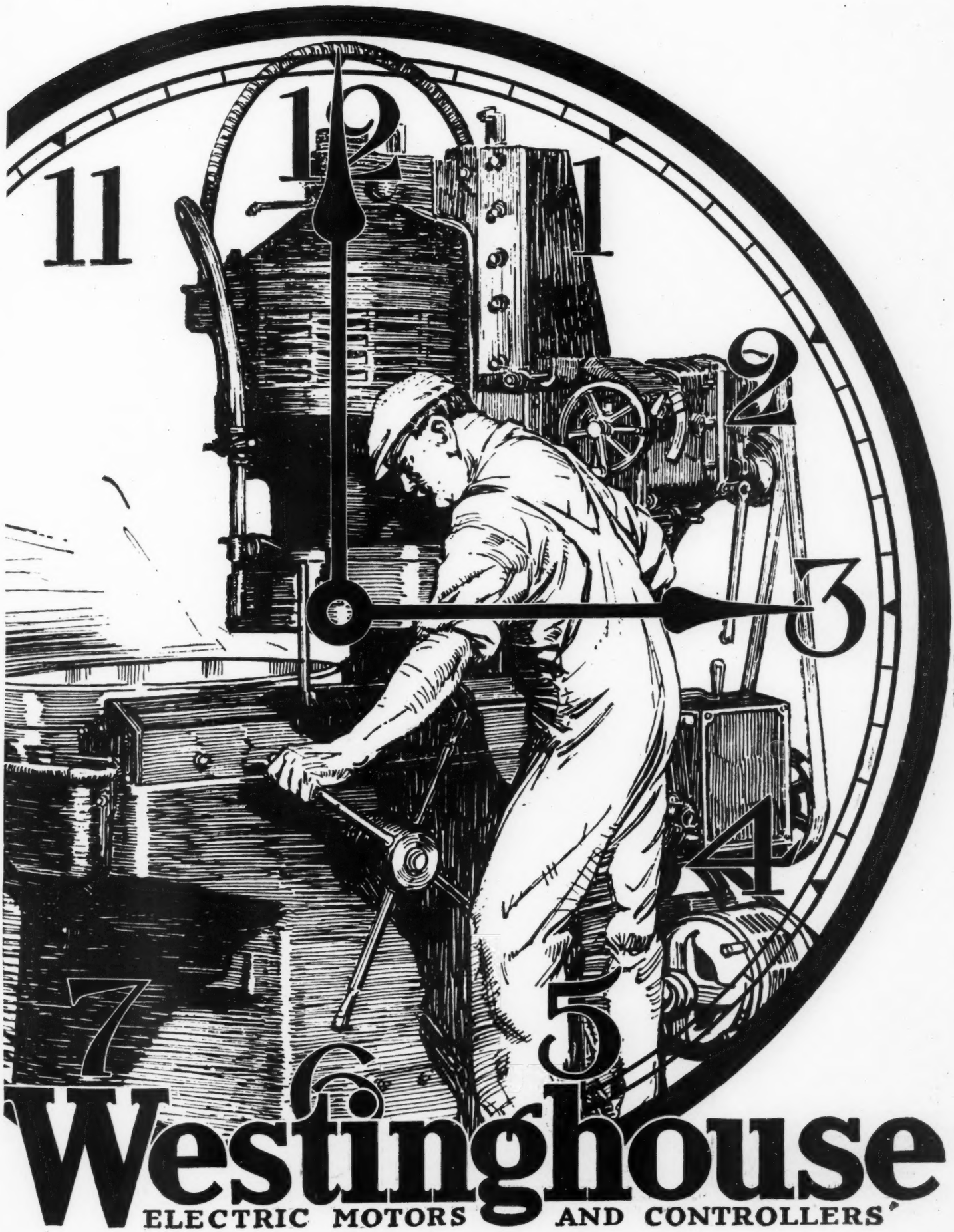
In applying motors to so many industries Westinghouse engineers have learned not only the power requirements of this machine and that, but the principles and practices of thousands of industries. When you buy Westinghouse Motors you buy not only machines well built mechanically and electrically, but service that can be offered only by men as thoroughly experienced as are the engineers and industrial specialists whose counsel and advice are always offered to the purchasers of these motors.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
East Pittsburgh, Pa.



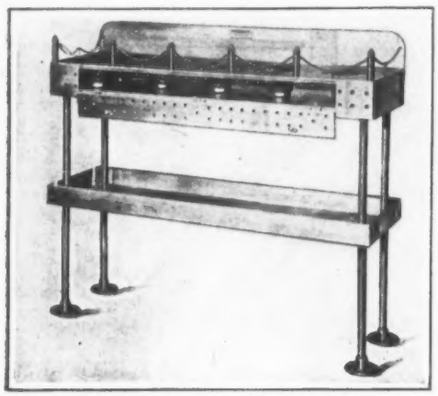
Westinghouse

ELECTRIC MOTORS AND CONTROLLERS

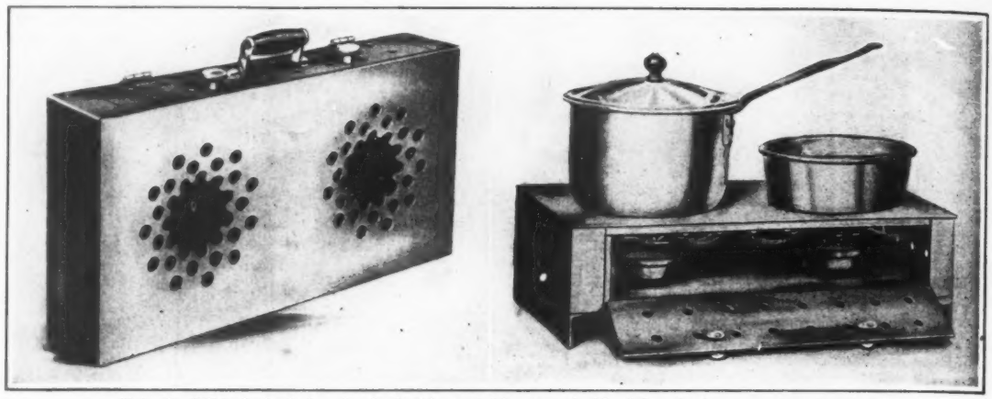

Westinghouse
ELECTRIC MOTORS AND CONTROLLERS

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



Insurance rates are materially reduced by the installation of this stove aboard yachts



Using solidified alcohol as its fuel, this portable stove is ideal for picnics, camping, boating, and other purposes

New and Novel Uses for Solidified Alcohol

FUEL for heating and cooking purposes in the trenches and in the field was one of the great problems confronting our Army in France. Someone suggested solidified alcohol, which is safe and convenient to handle, and burns without odor or smoke. Immediately the vast possibilities of solidified alcohol as a fuel for soldiers became obvious; and soon this material was being produced by the ton for the American troops in France. As a result, huge factories were constructed for the production of this novel fuel.

With the signing of the armistice and the gradual reduction of the warring armies, new uses have had to be sought for the vast output of solidified alcohol. And the man who did so much toward the application of this fuel to military life, by such inventions as the mess kit stove, airplane food carrier, hospital sterilizer, dugout heater, and other devices already described in these columns, has now turned his attention to more extensive applications of solidified alcohol.

The latest inventions of Mr. I. Popper of New York City, are a most convenient form of portable stove, and a special stove for the galley of a yacht or small boat. The first of these is shown in the combined illustration, both in the packed form and open for use. The stove is made in the form of a suitcase, of heavy steel, and is provided with a hinged drop which forms the front of the stove when it is erected. Folding feet beneath the stove serve to raise it an inch or so above the surface on which it may be placed. The fuel is supplied in the form of cans, which are placed beneath the burner holes.

The second device is a special stove constructed entirely of aluminum, and intended for use on board yachts and small craft. The particular stove illustrated herewith was constructed for Mr. Harry M. Bronner, and installed aboard his yacht, "The Neaugar." As in the case of the smaller stove, this stove uses solidified alcohol in cans which are provided with a shank at the bottom so as to fit into holes, thus preventing them from sliding about with the rolling of the boat. A railing is provided to prevent pots and pans from sliding off during rough weather. A demountable pan below serves to hold pots and dishes in the rather crowded galley. As for the heating properties of the fuel, it is said to be superior to most means of cooking. The flame of each burner can be regulated by means of a simple paddle-like member, which serves to cover more or less of the can opening. To extinguish the flame, the paddle-like member is placed entirely over the can opening, thus shutting off the air.

Portable Rail Sawing Machines

THE accompanying illustrations show a portable rail-saw, developed at St. Louis, Mo. These machines have been designed for efficiency, durability and economy, as realized by track maintenance departments. The hand-power machine has a saw blade of a diameter of 18 inches, the thickness of saw blade being $\frac{3}{16}$ inch and the maximum depth of cut is $7\frac{3}{4}$ inches. The approximate weight of the hand power machine is 350 pounds and of the motor-driven machine about 450 pounds.

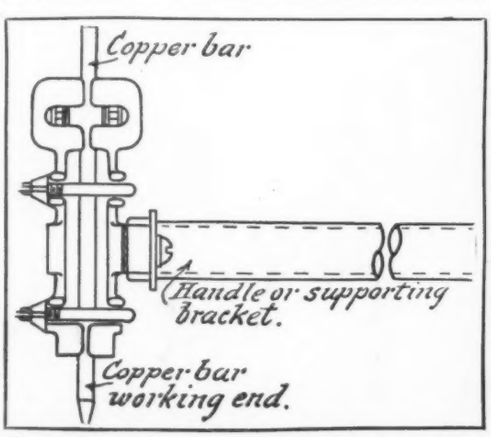
Close-up and action photographs of the portable machines for sawing rail ends

The machine is designed to cut off rails at any angle with their length. The saw blade starts cutting in the center of the head of the rail, and makes a true vertical cut at any angle, leaving the ends of the rail perfectly smooth and straight. The reducing gear is mounted on the slide, supporting the saw blade. The automatic feed lowers the saw at the proper speed for cutting through the head or base of the rail. A friction nut on the feed screw can be quickly released to feed the saw by hand through the web of the rail or in the return of the slide by means of a feed screw crank.

It will be noted that the saw blade is driven by an adjustable steel sprocket engaging the periphery of the saw blade, insuring a positive feed. The greatest possible capacity is thus obtained from both new and recut saw blades. The photograph shows the small nut necessary to hold the saw blade on its arbor, no large driving collar being necessary which would tend to reduce the blade capacity. The steel sprocket is adjustable to care for worn out or recut blades.

The motor-driven machine is suitable for cutting 135-pound steam rails, and any girder rail up to 7 inches high. By reversing rails that are out of track, after one-half of cut has been made, girder rails of

(*Continued on page 446*)



New soldering iron copper bar makes contact with a larger area than the heating units could touch directly

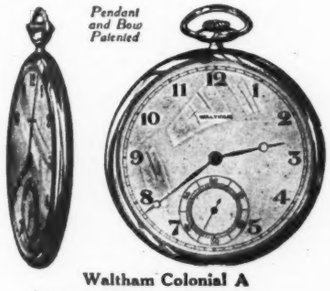
Soldering iron that heats the work indirectly

Suiting the Heating Tip to the Work

IN attempting to increase the rate of soldering the caps on the square tops of metal cartons used to carry biscuit to the Army during the war, it was found that the usual type of electric soldering iron was not as effective as a newly invented heater which was developed as a result of the need for speed in this work. In this device a larger surface of the heated portion touches the metal of the carton and less current is required than with the ordinary electric soldering iron. The design is radically different, the two heater units being secured to the insides of two cast iron pieces, between which a flat bar of copper about $1\frac{1}{4}$ inches wide by $\frac{1}{4}$-inch thick is clamped. This extends at one end and the heat generated in the flat heater units is transmitted to the copper bar, the end of which is the soldering tip and this heats up a good part of the metal carton cap at one time. When the copper bar wears it is easily extended by unloosening the clamps and when not enough is left to be in contact with the heater units, another bar is put in to replace it. This type of soldering device may be provided with a curved piece of copper instead of a flat bar to suit it to cartons of other shapes. A handle may be attached or a bracket for mounting on a support.

WALTHAM THE SCIENTIFICALLY BUILT WATCH

AND THE FOREIGN BUILT WATCH



Waltham Colonial A
Extremely thin at no sacrifice of accuracy
Maximus movement 21 jewels
Riverside movement 19 jewels
$135 to $255 or more depending upon the case

Know the "Works" of a Watch Before You Buy It

THE watch presents the same elements of mystery that once surrounded the automobile. Now, nearly every one knows something about a motor car's mechanism. It is to make the "works" of the watch an "open book" that these Waltham advertisements are designed—to instruct and protect you in buying a watch.

The mainspring is the power of a watch. It is a piece of specially hardened and tempered steel, about twenty inches long, coiled in a barrel between the upper and lower plates of the movement.

It is subjected to varying conditions of service in temperature and tension. The variation in thickness of two one-thousandths of an inch, or lack of uniformity in hardening and tempering, will decide the time-keeping quality of your watch.

The Waltham Watch Company produces fourteen tons of mainsprings every year. It is the largest mainspring maker in the world. The Waltham mainspring is cut from long rolls of steel of uniform and special quality, then tempered *in resilient form* by a secret process, and is placed in the watch coiled into a hardened and tempered steel barrel. This process originated at Waltham.

The *foreign* mainspring is not only cut *in short lengths*, but hardened and tempered *in short lengths* — therefore every foreign mainspring is an individual spring of uncertain temper, making the watch a liability.

The foreign maker of watch movements buys his springs in the open market. That is one reason why the imported watch gives such varying service. An inferior mainspring means an inferior watch — no matter how much you pay for it.

The uniform superiority of the Waltham mainspring is one of the reasons why the horological experts of the leading nations of five continents chose Waltham in preference to watches of any other make.

WALTHAM

THE WORLD'S WATCH OVER TIME

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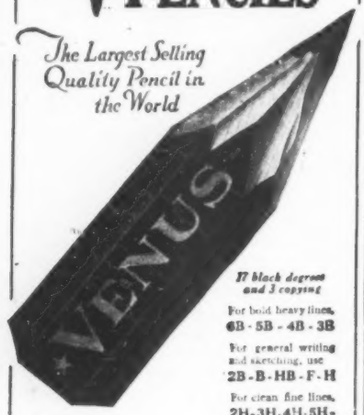
The Largest Selling Quality Pencil in the World



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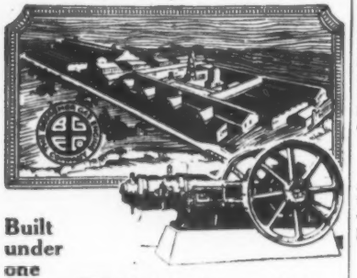

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Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.

Of General Interest

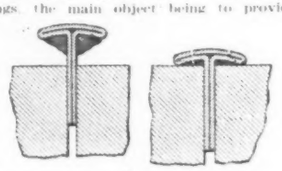
LAMP CHIMNEY.—E. B. GUINEE, Schuylerville, N. Y. This invention relates more particularly to the means provided on the chimney at the base for engagement by the spring fingers usually provided on the burner for retaining the chimney in position. The object is to provide means to receive the fingers of the burner and adapted to be engaged by the latter without giving the spring fingers or burner any special shape for the purpose.

FIREPROOF DOOR.—A. C. GODDARD care of Howell Field & Goddard, Review Ave. and Young St., Long Island City, N. Y. The object of the invention is to provide a fireproof door which is exceedingly strong and durable in construction, not liable to distortion and arranged to prevent flames from reaching the interior of the stiles and rails in case of a fire; a special feature is the use of corner pieces covering up the joints of the stiles and rails.

BOWLING ALLEY.—W. J. BARNETT, 506 Chestnut St., Brooklyn, N. Y. This invention relates to the construction of bowling alleys, and has particular reference to means for affording convenience and safety to the pin-boy. Among the objects is to so construct a bowling alley, having two runways that one boy may easily set both sets of pins, and to shield the boy from the flying pins or balls.

DAVENPORT OR CHAIR.—A. E. ANDERSON and H. FELDEN, 419 W. State St., Rockford, Ill. The invention relates particularly to the construction of davenport or chair ends, the object being the provision of an end construction which will enable wide range in thickness to suit davenports or chairs of light, medium and heavy construction, which will obviate loosening and rattling of parts and will present great strength and durability and avoid warping and disalinement.

COPING-JOINT SEAL.—J. A. LOVELY, 531 West Church St., Jacksonville, Fla. This invention relates to joints between blocks of wall copings, the main object being to provide a



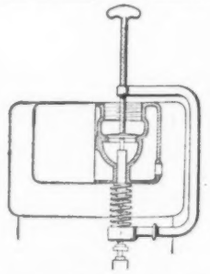
SHOWING THE SEAL IN A PRELIMINARY STAGE AND INSTALLED

waterproof seal for such joints. The invention provides for a joint seal consisting of a blank of soft metal folded and bent to form a T-shaped strip, including a double-walled convex or arched head and a double-walled web depending therefrom, the upper surface being convex insuring a permanent and waterproof joint.

FLAGSTAFF.—F. D. CRICHTON, care of Howard University, Washington, D. C. The object of the invention is to provide a device having a mounting for the flag which is slidable and pivotally connected with the staff in such manner that it may swing freely about the staff, the staff is provided with a ball-bearing supported roller or drum freely rotatable to prevent wrapping of the flag about the staff.

Hardware and Tools

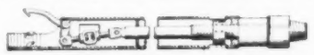
VALVE TOOL.—S. D. HEARING, 462 Sharon Ave., Zanesville, Ohio. The object of this invention is to provide a device for releasing motor valve springs, wherein a clamp is provided, having means for clamping the sides of the value



A SIDE VIEW OF THE DEVICE WITH THE VALVE CASING IN SECTION

spring and the support under the spring, and having a sliding clamp on the said means, adjustable for all sizes of springs to hold them firm while removing and replacing pins from the valve stems.

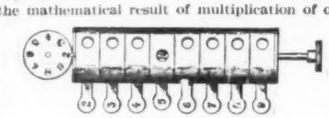
FISHING TOOL.—A. B. HEATON, Coalinga, Cal. The invention has for its object to provide a tool especially designed for insertion in a wide



A LONGITUDINAL SECTION OF THE TOOL

casing to recover lost and broken tools, wherein mechanism is provided for firmly grasping the tool to be removed prior to the removal of the tool and operable from the top of the well casing.

COMPUTING MACHINE.—P. FASSA, 224 25th St., Brooklyn, N. Y. Among the principal objects of the invention are to ascertain rapidly the mathematical result of multiplication of one



A TOP PLAN VIEW OF THE MACHINE

number by another, to provide a machine to assist educational institutions in the training of students, and to simplify the construction and cheapen the cost of the machines.

Heating and Lighting

SAFETY GAS TIP.—P. P. HEIN, 444 E. 79th St., care of Jos. Bory, New York, N. Y. This invention has particular reference to a gas fitting or appliance that will close automatically and so stop the flow of gas in the event that the flame is extinguished by any means. Among the objects is to provide a simple and certain expedient whereby the valve will be automatically closed almost instantly after the flame is extinguished or will close in the event of accidental openin of the valve.

Machines and Mechanical Devices

LABELING MACHINE.—A. POLLATSEK, 1310 Jefferson Ave., Brooklyn, N. Y. The invention has for its object the provision of a construction which is semi-automatic and which will apply and press labels on bottles, cans, and the like of different sizes and shapes, the parts being adjustable for taking care of different sized bottles and labels with equal pressure regardless of their size.

Pertaining to Vehicles

ANTISKID DEVICE.—R. FOGARTY, 10 Emmett St., Newark, N. J. The general objects of the invention are to provide a means for attaching chains or equivalent elements to the wheel so as to prevent skidding, the attaching means being in the form of an open spring ring that the

SIDE VIEW OF A WHEEL WITH THE DEVICE APPLIED

concentrically to and inwardly from the felly, and which has overlapping ends with nuts so as to prevent the ring from becoming automatically detached from the antiskid chains.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

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An Airman's Story

(Continued from page 426)

forty. There was an average of a plane to a pilot. Less than seven hundred American pilots saw service at the front, and many of these were with the Lafayette outfit before we came in. Most of these trained in France. There were very few American trained pilots who saw actual front line service. Of the planes, I think that 150 is an outside estimate for the American made variety. The rest came from wherever they could get them, England and France, of course. The Americans didn't always get what they wanted. I know one lad who was using a 220 Hispano Suiza engine which had been discarded by the French as not good enough! This was when the armistice was signed.

"The French Spads the Americans used were great machines. Of course you know the Fokker is a superior machine. Oh, much. But the Yankee airman had it all over the Boche. The Americans dropped five Boche for every one *they* got, superior skill and nerve, of course. Let me butt in on myself and tell you right here a little tale of the front about that nerve. They had brought down a Boche, the Americans, and he wasn't hurt. He was a pretty decent sort of fellow, too. Oh, yes, there were a lot that way. Well, airmen are a clannish sort and they do respect their opponents. You get so you know that the other fellow has guts, too, because you find out, 'specially if you ever get 'wind up,' what a lot of endurance it takes to stand the strain.

"Well, this German flyer was the right kind and he took his capture philosophically, and the boys let him sort of loaf around until the guard came for him. One day some one had a bright idea and asked him if he'd like to fly an American plane. The Boche thought he would. Maybe he thought he could put something over! So they asked him, if they let him, would he give his parole not to try to get away. Very properly he told 'em the German for 'nothing doing in the parole line.' And that made 'em laugh and they told him to climb into a machine, and get away if he could! Then three of them went up and flew rings 'round him and herded him all over the atmosphere and finally made him fly down and land where he started from! Pure deviltry, and if G. H. Q. ever heard about it, heaven only knows what they would have done, but no one told.

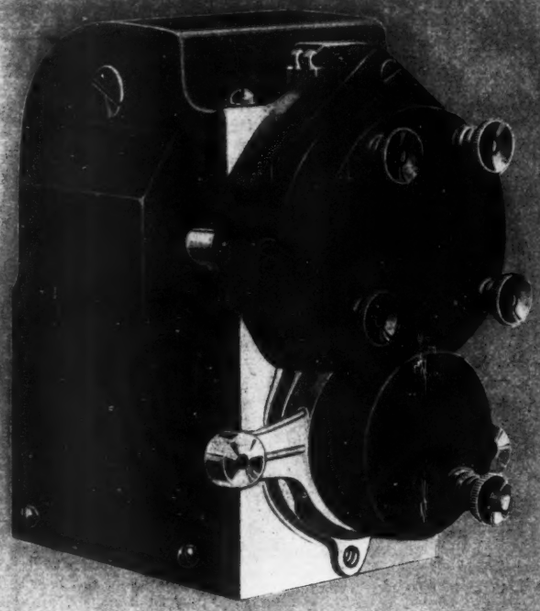
"But the point I'm making right here is this. Show me the American airman or the British airman, captured by the Boches and allowed to get up in the air, who wouldn't have either got away or crashed trying, and I'll show you an airman who doesn't belong!

"The Spad isn't a bad machine, you know. You can dive with your engine full on and stay together when you flatten out. But the Fokker has fewer blind spots than a Spad—much better visibility. I'm not sure that isn't why the mortality was so heavy among the U. S. boys in the air. The mortality was 50 per cent at least for the war. I know of one day-bombing squadron that lost 60 per cent of its men in one day, and that's sure burning up airmen to make a German holiday.

"But don't let any one think I'm knocking the best little nucleus of airmen in the world. The Boche knew that, they didn't like the sample America sent over at all, and if Foch had only had paresis or something before he signed that armistice and things had got to running a little smoother at home, maybe we would have gone in and bombed Berlin off the map.

"But it's all over now, and no one is going to do any more cloud dodging with Fritzie streaking it for home while you shoot his tail off him, same as Archie did for me, and America has a wonderful chance to get caught up on her plane production, so that France and England and Italy don't leave her altogether behind.

". . . . Sure I will. Here's luck. And say, make it to the U. S. A. in the air next time!"



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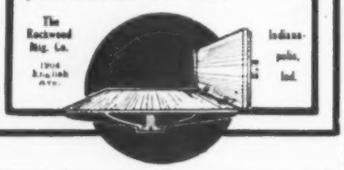

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The Growth of Ellis Island

(Continued from page 427)

formed between adjacent blocks. These slots are then filled with bags of concrete to form a key that will lock each block to the next one. On top of these blocks a concrete wall is built, faced with granite blocks, the stone being anchored to the concrete by means of cramp irons.

Around Islands No. 2 and No. 3 where deep water is not required, the original crib foundation has been utilized and on this is being built a new, molded concrete wall faced with granite, of the design shown in the lower left-hand corner of the title page illustration.

Supplying the British Farmer with the Sinews of War

(Continued from page 429)

as possible to be made in this country, and it was expected that over 60 would be available in time for the spring plowing. In addition to the above supplies, orders were placed for considerable quantities of horse-drawn implements, both for cultivation and harvesting, and arrangements have been made, not only to guard against a depletion of the existing supply of agricultural horses, but to purchase an additional 20,000 horses, which, with the increased supply of plowmen, will be urgently required to carry out the increased tillage program during the winter and spring months.

A different problem was presented in the case of fertilizers. The position in 1916 was briefly as follows: The supply of potash, for which Britain has depended on the rich deposits in Germany, had been cut off. The usual quantity of sulfate of ammonia was available—a large amount, however, as in former years, being exported—but only small supplies of Chili nitrates had been forthcoming. With regard to phosphatic manures there was a considerable amount of basic slag available from the steel works, but additional grinding machinery was required; in the case of superphosphate, the supply was limited by the munitions demands for sulfuric acid.

Fortunately it was found practicable to recover considerable supplies of potash from flue dust, and a limited quantity was got in time for use with the 1918 crop, while it is hoped to secure a greatly increased supply for the 1919 crop. As regards sulfate of ammonia, owing to active propaganda among farmers for an increased use of the fertilizer, the consumption has arisen from 78,000 tons in 1916 to close on 180,000 tons in 1917. Exports have been prohibited so that as far as possible the whole output might be available for food production and munition manufacture in the United Kingdom. In the case of phosphatic manures returns obtained in the spring of 1917 from the manufacturers showed that while some firms had supplies of acid, they were short of phosphate rock, and *vice versa*. Steps were accordingly taken to pool supplies with a view to more immediate production.

The provision of a proper supply of seeds and the control of prices have proved also matters of considerable importance. To insure against the possible shortage of seed wheat for sowing in the autumn of 1917 in the event of unfavorable harvest conditions, the Food Production Department secured a reserve of about 5,000 quarters of wheat of the 1916 crop. The Department also purchased and offered to farmers through the Agricultural Executive Committees 25,000 quarters of seed wheat of heavy cropping varieties and of high purity for autumn sowing in 1917. During the spring the greatest difficulty was encountered in obtaining seed potatoes. The serious shortage of the potato crop in Scotland and Ireland, from which seed potatoes are chiefly obtained, and the increased acreage of potatoes about to be planted, especially in Ireland, made it necessary to organize supplies, particularly for the small growers and allotment holders. The action of the Food Production Department in securing 15,500 tons for distribution through the War Agricultural Executive Committees was of great assistance to the allotments in a critical season. For 1918 steps were taken to provide 10,000 tons of immune varieties for districts affected with wart disease, to provide not less than 10,000 tons of non-immune varieties for small growers in other districts, and to arrange for the planting with immune varieties of 1,000 acres in Scotland and Ireland in order to furnish seed for infected areas in 1919. A vigorous campaign was carried on by the Departments of Agriculture in all parts of the United Kingdom for the spraying of potatoes against blight.

Attention having been drawn to the main factors in the agricultural program of 1917, the results, as represented in the acreage and produce of crops may be briefly stated. Here, however, it is necessary to bear in mind that, while in the United Kingdom the tillage area for 1917 was increased altogether by nearly one million acres, the evidence at the end of 1916 pointed to a fall in the area under crops in the 1917 season. Thus the effect of the campaign has to be judged, not only by the actual increase realized, but by the fact that a decline in the tillage area had been checked.

Considered in greater detail, the returns of acreage of crops in the United Kingdom for 1917 show an increase of 50,000 acres in wheat, of 140,000 acres in barley, of 616,000 acres in oats and of 220,000 acres of potatoes. The area under oats in 1917—4,761,000 acres—is the highest acreage on record in the United Kingdom, while the acreage under potatoes is the largest since the year 1889.

It is estimated that the yield of wheat exceeds that of 1916 by 5,000,000 bushels, of barley by the same amount, and of oats by over 36,000,000 bushels. In potatoes, where the season was exceedingly favorable for the crop, despite the shortage of potash, the yield is one of the highest on record the total crop exceeding that of 1916 by at least 3,000,000 tons, and the average crop of the preceding 10 years by 2,000,000 tons. Altogether it may be said that the tillage campaign resulted in the addition of not less than 600,000 tons of cereal food and 1,500,000 tons of potatoes on agricultural land.

The showing for 1918 is quite as favorable but shows, of course, no notable increase over 1917. It was in the last-named year that the machinery of war-time agriculture got under full headway, and it is for this reason that we speak so much of 1917 rather than later years. The outlook for the present and future is bright. Nothing has been more striking than the general efficiency and whole-hearted loyalty of the War Agricultural Executive Committees throughout the country in carrying out their novel and heavy duties, and it is no exaggeration to say that these committees have succeeded in raising the whole standard of farming and in creating a strong public opinion against the neglect or misuse of land which might be producing food for the nation.

Weighing High Temperatures in an Electric Balance

(Continued from page 431)

the same materials as the couple itself. This has the great advantage of bringing the cold junction right back to the measuring instrument, where its temperature is easily observed and compensated or kept constant, either manually or automatically.

The ability of the delicate and sensitive galvanometer to control the expenditure of a considerable amount of power has been taken advantage of to construct curve-drawing and multiple-circuit printing recorders, as well as to operate signal lamps and indicators at the furnaces. The recorder thus takes the place of an attendant, who would otherwise be required to read the pyrometer and signal its indications to those in charge of the furnaces. Perhaps this ability to work automatically

(Continued on page 444)

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Weighing High Temperatures in an Electric Balance

(*Continued from page 442*)

is the most significant feature of the new system.

Another interesting application of the potentiometer outfit is in connection with the preliminary experimental work necessary before heat treatment methods can be standardized. With all metals, there are certain well defined transformation points or critical points—temperatures at which chemical or physical changes take place. The operations of hardening, working, annealing and tempering must be carried out at temperatures bearing a definite relationship to the critical ones; and it is accordingly necessary to determine the latter with accuracy.

When a substance is heated to a transformation point, and allowed there to undergo the transformation, the latent heat necessary to do the work of the transformation in question is absorbed, but without increasing the temperature of the substance. When the critical point is reached by cooling, on the other hand, the process of transformation is marked by evolution of heat without any corresponding drop in temperature. Now when we boil or solidify or melt or condense a substance we cannot watch it and state at what moment the transformation takes place; things do not melt suddenly, after the fashion of an explosion. But if we know that the transformation is marked by constant temperature, a temperature that remains fixed in spite of the absorption or evolution of considerable quantities of heat, we can use the recording pyrometer to locate the critical temperature, with the greatest ease and accuracy.

In practice, the sample under test and another body having no transformation points within the range to be studied, are heated in close contact without another. This second body is termed the sample holder. It will become uniformly hotter (or colder) throughout the test, while the sample will fail to do this when its transformation point is reached. Accordingly, the difference in temperature between the two bodies, normally zero or almost zero, will take a sudden leap when the transformation point is reached.

We must measure both the actual temperature of the sample, and this temperature difference. The first of these observations is made by means of a potentiometer circuit, in the regular way. The second is effected through a pyrometer which has, instead of the more regular hot and cold junctions, one junction in contact with the sample and one in contact with the holder. In this way, it is constrained to record, not the difference between a known fixed and an unknown variable temperature, but rather the difference between two variable temperatures. Temperatures are plotted as one coördinate, the corresponding temperature differences at another.

So long as sample and sample holder heat or cool uniformly, there will be no change in the temperature-difference. But when the temperature of the sample remains stationary or lags behind that of the holder, due to a transformation in the sample, the temperature difference undergoes a change. This change may not be, in absolute figures, a large one. But the difference was zero, or approximately zero; so any change whatever is bound to be, on a percentage basis, a large one, eminently suited to being well brought out on the graphical record.

Interesting features are frequently brought out by the transformation point records. Sometimes the transformation does not arrest the change in temperature completely, but merely retards it—and in such event, the retardation is apt not to be uniform. Sometimes the transformation during heating and the reverse transformation during cooling—which are distinguished from one another by speaking of decalescence points and recalescence points, respectively—affect the rate of temperature change quite differently. This is well illustrated by the heating and cooling curves which we show herewith.

America's Great Effort in Ordnance

(*Continued from page 433*)

The Aberdeen Proving Ground consists of a tract of land about 35,000 acres in area, situated along the western shore of the upper arm of the Chesapeake Bay in Harford County, Md. It takes its name from the small town of Aberdeen, which is situated about four miles west of the camp headquarters. The project was a war measure and it was completely planned and executed since April, 1917. It will be continued as a permanent experimental firing ground. The reservation extends along the Bay Shore, as shown on the accompanying map, from Swan Creek opposite the Susquehanna basin to the Gunpowder River, a distance of about fifteen miles. Barracks, officers' quarters and proving batteries are situated near the northern end of the reservation, leaving the main portion of the grounds clear for firing, except that a part of Gunpowder Neck is occupied by the gas plant of the Edgewood Arsenal.

The purchase of the land was approved by Congress early in October, 1917. The surveys were undertaken four days later, and the first shot was fired on January 2d, 1918, in the midst of a violent snowstorm. Since that time, construction work and firing proceeded in unison. Today there are quarters for some 8,000 men on the post and there have been invested in construction some $10,000,000. Over 400,000 rounds of minor, medium and major caliber ammunition have been fired. As a comparison with previous conditions before the war, it is interesting to note that on a single day about 7,600 rounds were fired at Aberdeen—more than were fired in the whole year of 1916 at Sandy Hook.

The Proof Batteries and Ranges

The majority of the proof ranges and batteries are situated adjoining the barracks for officers, etc., near the northern end of the reservation. There are five parallel ranges, each extending generally in a southwesterly direction and inclined at a slight angle with the Bay Shore. In this direction there is available a range on land of 15 miles and a clear range over water of 40 miles.

The length of the main proof battery is 2,500 feet, and here are tested the following guns: 37 mm. gun; 75 mm. gun; 3-inch gun; 4.7-inch gun; 155 mm. howitzer; 155-mm. gun; 5-inch gun; 6-inch gun; 8-inch howitzer; 9.2-inch howitzer; 240-mm. howitzer; 12-inch howitzer. The clear land range is 15 miles, but ranges up to 75 miles can be obtained over water.

The trench warfare range has a total length of 1,000 feet and the mortars tested there are the 3-inch Stokes, 4-inch Stokes, 6-inch Newton Stokes, 240-mm. trench mortars, rifle grenades, and hand grenades. On the trench warfare range also are carried on various experiments in pyrotechnics, and with incendiary and gas bombs.

In the first chapter of this article it was stated that the Allies asked us to concentrate on large railway-mount guns, and in this direction we produced some exceedingly fine artillery, the test of which took place on a railway-mount range, which is made up of about ten tracks, so arranged that the guns on these tracks will have a clear range up to 75 miles. Electric or gasoline locomotives are always on hand at this range to assist in placing the guns.

In addition to the ranges above mentioned, there is what is called a water range. The firing is done down the Chesapeake Bay and the fall of shots is over a shoal which extends approximately down the center of the Bay and is, therefore, well clear of all shipping. The splash of the shots as they fall into the water is recorded from 13 towers built on the western shore of the Bay, in which observers are stationed. These observers take a reading

(*Continued on page 446*)

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Book is attractively bound. People all want this book. The prohibitionists like the hundreds of health-giving beverages which can be made at home and the others want formulas which do not require stills or other parphernalia of the distillery or the brewery. The information contained will be of interest to all.

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America's Great Effort in Ordnance

(Continued from page 444)

of every shot; and these readings are then collected, triangulated and the exact range obtained. Means of communication between these towers is by wireless and by the ordinary commercial telephone.

There are also three other ranges which were used for the testing of high explosive shell. These are isolated, in order to protect the inhabitants of the Proving Ground from the extreme danger which is always present when high explosive is fired.

In the late spring of 1918, the first United States guns on railway mounts came through. In February to May, 1918, an improvised fixed gun carriage was constructed at Sandy Hook and from it the 8-inch and 10-inch guns were range fired with new light-weight projectiles. In April the 14-inch naval gun was tested at Sandy Hook and about the same time the first complete railway artillery unit, the 14-inch, 50-caliber naval gun, mounted on a railway carriage, arrived at Sandy Hook and proved a great success from its first appearance. The next gun to be tested on a railway mount was the 12-inch mortar and at this time all big gun testing was transferred from Sandy Hook to Aberdeen and tried out at the water-range battery on a series of spur tracks. The initial complete 8-inch railway mount reached Aberdeen about June 1st, and it was followed shortly after by the first 16-inch Howitzers. Other guns which arrived were the 8-inch railway guns, 7-inch naval guns, and 12-inch mortars on railway carriages.

Aerial Bomb Testing

The Proof Department, in charge of Major F. P. Lindh, is divided into several sections, to which some reference has already been made. Particularly interesting is the instrument section which has charge of all photographic work, of velocity, time and powder pressure measurements.

The section was housed in a permanent brick building, and it will be in a position to do excellent research work when the pressure of routine work decreases. Mention should be made of the Aberdeen chronograph, an entirely new type, much more compact than the standard type which has hitherto been in practically universal use. This chronograph is the work of Lieut. Alger, and it has given complete satisfaction in the work at Aberdeen.

The development of high angle fire made a study of the conditions of the upper atmosphere very important. A detachment of the Meteorological Section, Signal Corps, was sent to Aberdeen in March. Measurements of wind and density aloft were made several times daily and the station grew to be the best of its kind in the United States. It is now possible to obtain accurately the change in position of the point of fall of a projectile in both range and deflection, that would be caused by a wind aloft, however variable, within five minutes after a sounding balloon has been observed to the height desired.

The principal night activity at Aberdeen was that of testing anti-aircraft fuses. Since the flashes of shell bursts were more visible at night, tests were usually conducted from midnight on. Over 10,000 anti-aircraft and over 40,000 other types of time fuses were tested at Aberdeen during 1918.

Then there was the Acceptance Section of the Proof Department, which performed all the tests of manufacturers' samples. It was divided into tests of powder and projectile cases, fuses, complete rounds, a d bombs. About two-thirds of the total testing in the United States was done at Aberdeen and so great was the pressure of this work that frequently tests were carried on twelve and fifteen hours a day. This work alone involved the firing of about 200,000 rounds up to January 1st, 1919.

Testing Projectiles

Projectiles were tested by firing them under excess powder pressures to a chosen field, 5,000 yards or so from the guns and then digging them up for examination, and if you ask any of the enlisted force who are engaged in this work, they will tell you that the daily routine of digging up shells that are buried from three to six feet deep in clay mud and water, lacks all the elements of romance. On account of the percentage of large shells lost beyond recovery because they penetrated below the water level of the marshy soil, a concrete tank of large dimensions was built, into which the projectiles to be tested will be fired at close ranges. We had the pleasure of seeing a test of this tank and it promises to form a valuable feature of future Proving Ground work.

Limitations of space prevent entering in any more detail into a description of the enormous activities at Aberdeen, but we will close by giving some particulars of the rounds fired since the organization of the establishment. From January 1st, 1918, to December 31st, 1918, a total number of 450,000 rounds was fired; the month of greatest activity was August in which 71,000 rounds were fired; the maximum week was August 10th to 17th, in which 21,000 rounds were fired; the maximum day was August 9th, in which 7,700 rounds were fired.

In conclusion, we wish to express our indebtedness to Col. William A. Phillips, commanding officer at Aberdeen, and to Major F. P. Lindh, for courtesies extended during our visit to the Proving Ground.

Portable Rail Sawing Machines

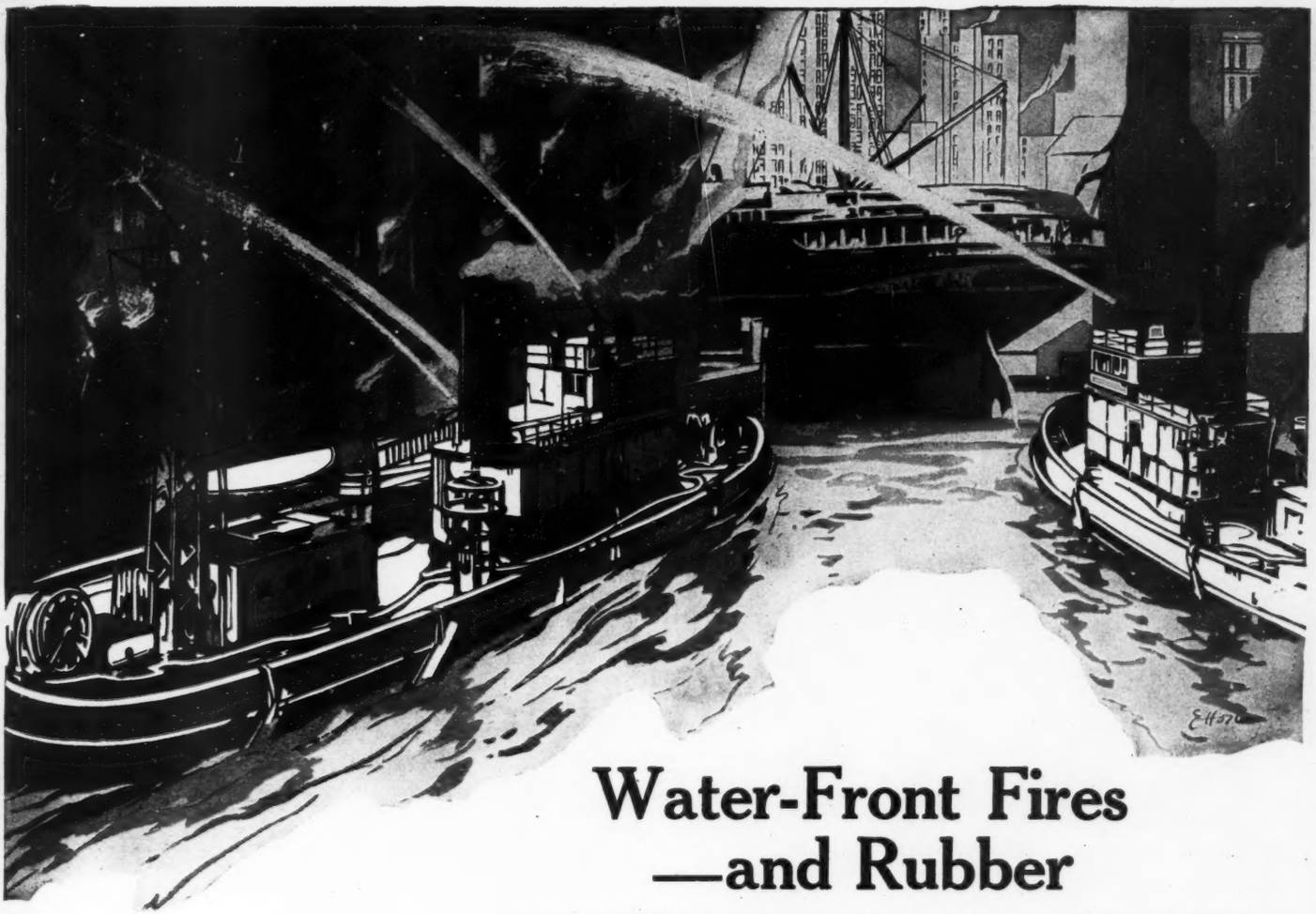
(Continued from page 438)

larger size can be cut. These machines have 18-inch diameter saw blades and special semi-high or high-speed steel blades are utilized, the high-speed blades being used for cutting high-carbon open-hearth rails. The motor-driven portable rail saw is especially necessary when the rails in an entire section are being repaired and new rails installed in places. The worn or battered ends of old rails may be sawed off in track, instead of being transported to shop or mill. The life of many old rails is thereby greatly prolonged for service. After a cut has been made, it is only necessary to release the rail clamping device, and throw the roller at the rear of the machine into position on the rail. The weight is then carried by the roller and machine will slide to the next position.

There has been provided on the motor-driven saw a friction device on the vertical driving shaft which permits the blade to operate at a reduced speed when cutting rails with hard spots and there has been designed a compact, but efficient, saw grinder for sharpening blades, which can be attached to a bench in the shop or on the portable power plant. This grinder operates at a speed of about 1,200 revolutions per minute.

The Crystal Structure of Ice

THE X-ray study of the crystal structure of ice by a prominent scientist was rendered difficult by the fact that the rays tend to melt and to sublime the ice. In a first attempt to turn the difficulty the whole system was encased and cooled by ice and salt; later a small ammonia machine was used which stopped the melting but not the sublimation of the ice; finally the crystals were encased in gelatin capsules in which they could be preserved for days. The isolation of a crystal also caused difficulties. The prismatic commercial ice, consists of distorted crystals which proved unsuitable for examination; from a layer of ice 2 millimeters in thickness, produced by pouring water into a pan, individual crystals could hardly be extracted; finally ice was frozen out of a weak salt solution which yielded crystals with distinct cleavage planes. The crystals were found to be hexagonal, as is generally assumed, and could be referred to four inter-penetrating triangular space lattices, and to two axes meeting at an angle of 120 degrees, and a third axis vertical to the former.



Water-Front Fires —and Rubber

A row of buildings on the water-front is ablaze. Heavily stored warehouses are threatened. A liner, freighted with human lives and costly cargo, is tied up at the pier.

Complete destruction seems inevitable.

But the fire-boat is coming! Soon a whole broadside of water—50 tons a minute—is tearing into the flames with an impact so powerful that walls tumble and roofs are ripped away.

And what is back of this tremendous force?

Rubber—that multiform material which has become so helpful an ally to man—a substance that has given him control over the most destructive of all elements—fire.

The endless flood of water shooting into the flames, passes through fire hose that is lined with rubber.

And the steam hose is rubber. Rubber is in the packing of gates, pumps, pipe-lines and propeller stuffing box. It is used for the big suction and discharge valves and for washers and gaskets of many kinds.

Even in less conspicuous details, rubber is freely used. Insulation is made of it; so are the coats and boots of firemen. Floors, stairs and platforms are covered with it. No matter where you turn you will find rubber in some one of its myriad forms.

And most of the rubber you see came from one or another of the 47 mills of the world's largest rubber manufacturer whose products bear the well-known U. S. seal.

Consult our engineering bureau regarding your rubber requirements. You can get in touch with it through any of our numerous branches.

UNITED STATES RUBBER COMPANY
US
RUBBER SYSTEM
AND ASSOCIATED COMPANIES

United States Rubber Company

How did you feel last April?

"If the War would only end I'd give anything"

HOW often in the long, long days of last winter did you say that to yourself? The shadow of war was on the land. The boys were going—perhaps your boys. You said: "I'd give anything" and you meant it.

Now the war is over. Over because of the bravery of our boys. Over because those boys were given the huge quantities of munitions necessary for victory.

Now the price of Victory must be paid.

The money from the Victory Liberty Loan is to pay for the shot, shells, guns, ships, and other supplies which made the war end sooner. Our Government spent money—huge quantities of money—because it knew that you and I and every American preferred to spend money instead of lives. If it skimped on money, more lives would have been lost—and the war might still be going on.

This loan is a challenge to our honesty—a trial of our patriotism. Are we going back on our spoken and unspoken promise: "I'd give anything"?

Ask yourself that and then subscribe to the very limit of your ability. Ask yourself what it is worth to you to have peace and then increase your subscription accordingly.

LIBERTY V LOAN

Victory Liberty Loan

The "Clean-up" Button

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Specify LONG-BELL Trade-Marked Timbers

BECAUSE of our good long leaf Southern Pine timber, modern mill equipment and careful supervision of manufacture and grading, our trade-mark on timbers assures you that they are up to grade specifications.

LONG-BELL

THE MARK ON QUALITY LUMBER

Six of our thirteen modern lumber and timber manufacturing plants are located in our large holdings of Calcasieu Pine. We can supply timbers up to 60 feet in length and of any size that these trees will make. Calcasieu long leaf Southern Pine timbers, because of their strength and durability, are especially well suited to all forms of heavy wood construction. To be sure of uniform high quality, specify LONG-BELL trade-marked lumber products.

Ask your dealer for LONG-BELL brand

The LONG-BELL Lumber Company

R. A. LONG BLDG. KANSAS CITY, MO.

Manufacturer of Southern Pine, Hardwood, Oak Flooring
Creosoted Lumber, Ties, Posts, Poles, Piling and Wood Blocks

How did you feel last April?

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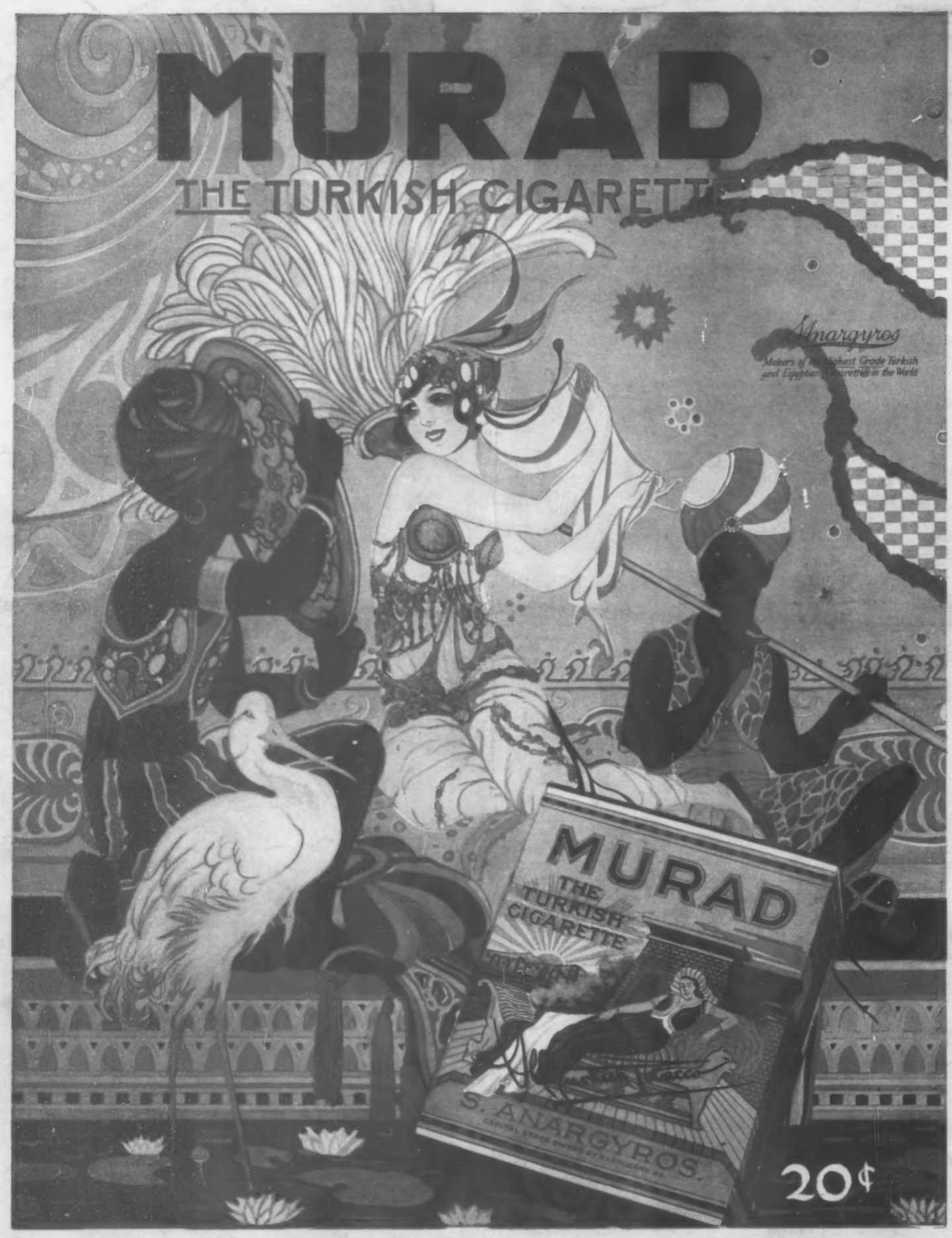
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